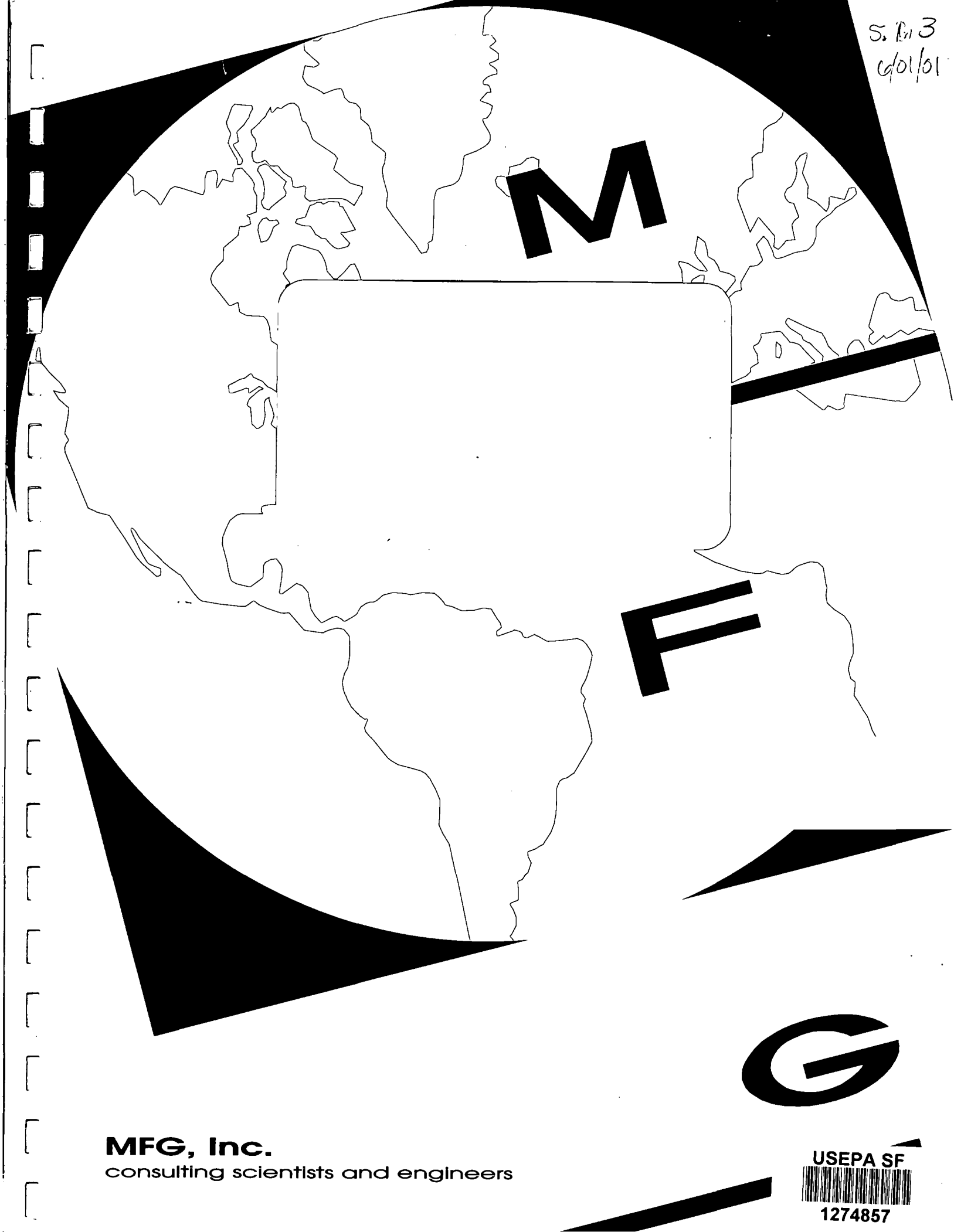


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# STATEMENT OF QUALIFICATIONS

*for Supervising Contractor  
for the J.R. Simplot Company  
at the Eastern Michaud Flats Superfund Site*

June 2001

*Prepared in accordance with  
Section 10a. of the Consent Decree*

*Prepared by:*

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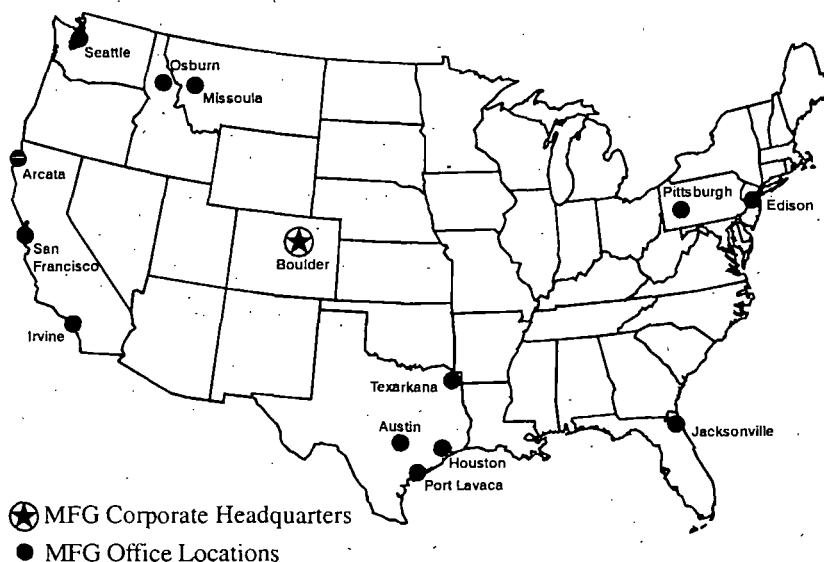
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## A COMPANY OVERVIEW

*MFG provides professional environmental science and engineering consulting services to private and public sector clients. Our expertise, experience, and services include site investigation and remediation, atmospheric sciences, hydrogeology, geochemistry, aquatic and terrestrial ecology, computer modeling, geographical information systems (GIS), water resources evaluation and development, solid waste and wastewater management, human health and ecological risk assessment, regulatory assistance, engineering design and construction management.*

The MFG corporate mission is to be responsible advocate for our clients. We encourage long-term client relationships by providing technically sound and cost-effective environmental consulting and engineering services. We combine science and engineering knowledge with sound project management, cost control, scheduling, and quality assurance practices to meet our clients' objectives. *The core principles and policies contributing to our mission include the following:*

**CLIENT VALUE** – We define value as the sum of expertise, experience, and innovation applied to cost-effective and efficient project results. **QUALITY RESULTS** – We strive for quality, not only in project designs and reports, but in all aspects of company operations that affect our service to clients. **UNITY OF APPROACH** – Our skills are fully integrated so that we can bring the very best individuals to a project. We strive to develop collaborative approaches to problem identification and resolution by working as a team with our clients. Teaming with outside expertise is also encouraged to meet the often unique demands of complex problems. **PROJECT UNDERSTANDING** – We strive to anticipate and understand client needs and project requirements. **COMMUNICATION** – MFG stresses ongoing communication with our clients on all aspects of a project (technical, legal, schedule, and budget) and within the context of changing business, technology, and regulatory requirements. **PEOPLE** – Our personnel are experienced, results-oriented, and skilled at working productively with client representatives and regulatory agencies to achieve reasonable and practical solutions. MFG provides a broad range of expertise, experience, and services by physically and/or electronically integrating staff and resources from our regional offices as appropriate for specific project needs.





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## ***KEY ENVIRONMENTAL SERVICES***

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### ***Integrative Environmental Services***

- Air Quality Permitting
- Aquifer Characterization Studies
- CERCLA Remedial Investigations/Feasibility Studies
- Compliance Support for NPDES Permits
- Computer Modeling Services
- Data Management and Statistical Analysis
- Environmental Impact Assessments & Statement
- Geographic Information Systems
- Groundwater Modeling Services
- Human Risk Assessments
- Legal Support
- Natural Resource Damage Assessments
- Pollution Prevention and Compliance
- Regulatory Assistance
- Site Investigations and Assessments
- Solid Waste Management
- Surface Water Discharge Permits
- Watershed Analysis and Planning

### ***Air, Surface Water, Land, and Groundwater Environments***

- Air Quality Studies
- Bioassessment and Biomonitoring
- Deep Well Design and Installation
- Environmental Noise
- Erosion Assessment and Control
- Management and Restoration of Lakes, Streams and Reservoirs
- Mine Hydrology and Geochemistry
- Nutrient Management
- Odor Assessments
- Stormwater Management
- Surface Management
- Vadose Zone Assessments
- Water Resources Development
- Water Resources Monitoring

### ***Treatment and Remediation***

- Constructed Wetlands and Bioremediation
- Construction Management
- Groundwater Remediation
- Habitat Restoration
- Reclamation of Disturbed Lands
- Remediation Management
- Soil Remediation
- Wastewater Treatment and Management





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## AIR QUALITY PERMITS

*MFG provides technical assistance with the, often complex regulatory processes of obtaining international, federal, state, and local air quality permits.*

MFG has represented private sector clients and agency proponents throughout the air quality permitting process. Our experience and services include source characterizations, impact studies, site acceptability reviews, expert testimony, representation, and assistance during regulatory reviews and hearings. MFG strives to anticipate potential regulatory problems and develop efficient solutions that address specific client needs.

MFG's experience in air quality permitting includes:

- Title V - Federal Operating Permit Program;
- Prevention of Significant Deterioration (PSD) program;
- State air quality construction permits;
- State air quality operating permits;
- Preparation of air quality sections for NEPA and state environmental impact statements;
- Compliance order and consent order resolution;
- State Implementation Plan (SIP) preparation; and
- Air quality section of RCRA Part B applications.

MFG staff has participated in numerous permitting efforts. These include several pulp and paper mills, a new Portland cement plant within a PM10 nonattainment area and Prevention of Significant Deteriorations (PSD) considerations, several cogeneration facilities, fossil fuel power plants, large fish-processing plants, aluminum reduction plants, copper and molybdenum smelters, coal gasification plants, coal and coke import/export facilities, and numerous open pit coal mines. Specific projects include:

- Conducting air quality analysis and obtaining air quality permits for a coal mining operation near Palmer, Alaska;
- Remediation of leaking gasoline storage tanks in Yosemite National Park. This project required extraordinary management coordination to secure applicable air pollution control permits and to obtain the necessary equipment to complete the remediation within the brief period scheduled for property transfer; and
- Preparation of a Clean Air Act Title V operating permit application for Coos County, Oregon to improve its solid waste incinerator, in existence since the late 1970s, which required major engineering changes to comply with requirements of laws recently enacted by the State of Oregon.



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## ***CERCLA REMEDIAL INVESTIGATIONS/FEASIBILITY STUDIES***

*MFG provides technical support to meet Superfund requirements with a multidisciplinary approach to the RI/FS process, including risk assessment, site characterization, remedial alternatives evaluation, engineering design, agency negotiations and community relations.*

MFG has the experience, technical expertise and knowledge to ensure compliance with state and federal regulations and the technological requirements typical of Remedial Investigations and Feasibility Studies (RI/FS). Where appropriate, MFG utilizes the flexibility inherent in CERCLA and in state regulations to streamline the RI/FS process by promoting site-wide Master Plans for RI/FS activities, rather than costly operable unit approaches. Where appropriate for site-specific conditions, we also implement presumptive remedy procedures and similar mechanisms promoted in regulatory guidance to achieve additional cost savings.

MFG promotes a risk-based, results-oriented approach to RI/FS activities. This approach focuses remedial investigations on gathering information to address the data needs of candidate remedial alternatives identified through preliminary screening against technical, economic and other recognized criteria. Our approach reduces the effort and cost associated with data collection during the RI.

MFG's experience covers all aspects of CERCLA requirements: managing PRP-led removal activities at sites; projecting and evaluating EPA's Hazard Ranking System (HRS) scoring; and preparing scoping documents, work plans, field sampling plans, quality assurance/quality control plans, health and safety plans, etc. We complete remedial investigations, including data collection and evaluation, assessment of ARARs, ecological and human health risk assessments, treatability studies, and report generation. We also complete feasibility studies (FS), including remedial alternatives development and screening, alternatives analyses, report generation, and negotiation support for consent decrees. We prepare Remedial Design Reports, constrained to the scope and cost of

required actions identified in Records of Decisions; provide construction oversight of CERCLA removal and remedial actions; conduct air and water quality performance monitoring and reporting; and offer Technical Support for recovery of CERCLA response costs incurred by PRPs from insurance companies. MFG has successfully completed or is currently involved in RI/FS projects for numerous sites, including:

- A metals mining and refining site in northern Idaho that is geographically the second largest CERCLA site and contains more than 30 million cubic yards of mine tailings and soil contaminated with cadmium, lead, zinc and other heavy metals;
- Fixation/stabilization/solidification of approximately 6,500 cubic yards of lead- and acid-contaminated soil at a former lead battery recycling site in Torrington, Wyoming, and of 15,000 cubic yards of lead-contaminated soil at a scrap recycling facility in southern Idaho;
- A 1,100-acre operational fertilizer manufacturing site in southern Idaho with soil, groundwater and air impacted by heavy metals, fluoride and radionuclides;
- A former lead battery recycling site in northern Texas with soils impacted by lead, arsenic and antimony and groundwater impacted by chlorinated organic compounds and petroleum hydrocarbons; and
- A Gulf Coast site involving more than 3,500 acres of bauxite refining/aluminum smelting operation and more than 60 square miles of associated marsh and estuary.





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## ***COMPLIANCE SUPPORT FOR NPDES PERMITS***

*MFG staff provide compliance support for NPDES discharge permits and produces permit modifications for industry, mining facilities, and Publicly Owned Treatment Works (POTWs).*

MFG has aided clients with all aspects of federal and state National Pollutant Discharge Elimination System (NPDES) and stormwater discharge permitting. Clients include a variety of industrial, mining, manufacturing, and municipal facilities. Our experience negotiating permit conditions and limitations has included evaluating best available treatment technologies applicable for discharges, evaluating the applicability of effluent permit limits and instream standards, and providing technical support and management of monitoring studies. We have prepared pre-treatment permit applications and conducted permit negotiations for a variety of industrial and mining clients.

MFG's services to clients include:

- Conducting wastewater and stormwater compliance audits for industrial facilities;
- Designing and implementing NPDES monitoring programs for ambient surface waters, effluents, stormwater and sediment;
- Designing and implementing clean methods monitoring programs to determine permit compliance;
- Preparing stormwater pollution prevention plans and storm water monitoring plans;
- Providing permitting support for the discharge of treated groundwater;
- Providing permit reviews and state and federal regulatory requirement reviews;
- Performing surface water modeling to support NPDES permit applications;

- Conducting waste load allocation (WLA) studies under the total maximum daily load (TMDL) framework;
- Developing metal translators for permit limit modifications and to translate between state and federal permit requirements;
- Performing managed Toxicity Reduction Evaluations (TREs) and Toxicity Identification Evaluations (TIEs); and
- Reviewing state and federal antidegradation requirements as they apply to new and existing discharges.

Our representative project experience includes:

- Design and implementation of studies to develop metal translators for the City of Flagstaff (Arizona) WWTP and for a large copper mining complex;
- Implementation of special monitoring studies for dissolved oxygen and nutrient assimilative capacities in effluent dominated waters in Colorado, Arizona, and California to evaluate the diel dissolved oxygen (DO) dynamics and why instream DO standards were not being attained in four river systems in these states; and
- Evaluation of the potential benefits of alternative analytical methods (total recoverable versus the potentially dissolved methods) for effluents in the amended water quality standards for trace metals specified in the NPDES permit for the Louisville (Colorado) WWTP.



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## COMPUTER MODELING SERVICES

*MFG has considerable experience developing analytical and numerical models and customizing existing state-of-the-art software to efficiently address project-specific needs.*

MFG maintains an extensive library of computer programs to assess the effects of natural processes and human activities on the physical and chemical conditions of surface water, groundwater, soil and air media. Data processing for all models can be further enhanced by the use of commercial databases, spreadsheets, computer-aided designs, geostatistical and contouring software, and various statistical analysis packages. Our graphical illustrations of model input and output effectively communicate the modeling concepts and their results. Our experience with computer modeling techniques is diverse.

**Groundwater**—Evaluation of past, present, and future extent and movement of contaminants; design of contaminant recovery and isolation systems; evaluation of the hydraulic characteristics of constructed wetland treatment systems; evaluation of surface water-groundwater interactions; design of dewatering and depressurization systems; design of saturated and unsaturated zone monitoring systems; and evaluation of aquifer testing data.

**Surface Water**—Analysis of water surface profiles in channels and rivers for flood events; design of diversion channels and detention ponds for contaminated and uncontaminated drainage; design of water treatment basins; analysis of runoff hydrograph events and design of channel floodways; design of various pipelines and piping networks; evaluation of watershed runoff and sediment loading; evaluation of contaminant migration and transformation in streams, ponds and reservoirs; and evaluation of mixing zone phenomena.

**Air**—Evaluation of mobile source impacts; preparation of Prevention of Significant Deterioration (PSD) permits and State

Implementation Plans (SIP); analysis of photochemical oxidants in urban airsheds and for individual facilities; evaluation of visibility degradation; health risk assessments; preparation of risk management prevention plans for accidental releases of acutely hazardous materials; prediction of long-range transport; and evaluation of odor impacts.

**Environmental Noise**—Evaluation of noise from transportation and industrial sources; evaluation of airport noise using the Federal Aviation Administration's Integrated Noise Model; assessment of point source noise transmission and attenuation; evaluation of the impacts of meteorology, ground effects and topography on long-range environmental noise attenuation; and interpretation of the enhanced version of the Federal Highway Administration's traffic noise model (STAMINA/OPTIMA).

**Waste Disposal/Containment**—Assessment and design of synthetic and natural landfill liners, caps and covers; assessment of slope stability; delineation of potential soil failure surfaces; development of hydrologic balance models to evaluate the movement of water into and out of landfill cells; development of atmospheric models to predict dispersion of gases and dusts from completed landfill cells; and groundwater modeling to assess the design and effectiveness of slurry walls and interceptor trenches.

**Geochemistry**—Assessment of processes influencing the chemical composition of natural waters; and assessment of factors (e.g., complexation, adsorption) controlling the mobility and attenuation of metals, other inorganic parameters and organic compounds in the subsurface.



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## **DATA MANAGEMENT AND STATISTICAL ANALYSIS**

*MFG develops and manages databases that are easily integrated with standard and customized statistical analysis packages, allowing an array of analyses to detect and define key relationships in the data.*

MFG compiles and manages large databases composed of extensive physical, chemical, and biological data collected across various media, including groundwater, surface water, soil, and air. We also have produced and maintain extensive literature databases and Geographic Information Systems (GIS) that address various aspects of environmental information.

MFG compiles and maintains these databases using computer software programmed specifically for the needs of each project. These databases can be easily updated with new data and can include a wide selection of data-handling and processing capabilities, such as graphics generation, data validation, statistical evaluations, and report generation.

MFG databases are easily integrated with standard and customized statistical evaluation packages, allowing an array of statistical analyses to be performed on specific data from the database. These databases have been used to aid our clients with decision-making and problem solving. For example, in obtaining permit modifications, we have been able to replace required statistical protocols with alternative analyses that provide results better suited to address the objectives of the study. This has helped avoid costly and unnecessary monitoring requirements resulting from false positive or false negative statistical results potentially obtained by using other, inappropriate, statistical applications. MFG staff have also managed databases and provided statistical analyses at facilities regulated under various state and federal mandates (e.g., CERCLA, RCRA Subtitles C and D, and NPDES).

The experience of MFG staff in data management and statistical analysis includes:

- Quarterly database management, data validation, statistical analyses, and permit modifications at RCRA Subtitle C treatment, storage and disposal facilities and other industrial facilities;
- Data validation and basic data reporting at the Bunker Hill Superfund site in Kellogg, Idaho;
- Historical data compilation, validation, and management at the Butte priority soils Operable Unit in Butte, Montana;
- Groundwater data validation and database management at Simplot Company Eastern Michaud Flats Superfund site in Pocatello, Idaho;
- Database generation, management, and statistical evaluations at various western U.S. mining and milling sites;
- Reanalysis of an EPA database to reject their earlier claim that results from whole-effluent toxicity (WET) testing were correlated directly with impact in receiving waters;
- Analysis of benefits from regional scale surface water quality restoration efforts; and
- Various comprehensive literature databases, compiled as part of RI/FS work on aquatic ecosystem effects, analytical methods, and treatment technologies for fossil-fuel processing effluents; acid rain and its effects; trout-habitat relationships; and benefits of constructed treatment wetlands on metals removal.
- Design and development, data validation, and statistical analysis of a database containing all publicly available drinking water and ecological resource data for three states: California, Louisiana, and Texas. The database was fed into a GIS model that uniformly applied filter criteria to the data in order to identify unusually sensitive areas where a hazardous liquid pipeline accident would likely cause permanent or long-term environmental damage. This effort was conducted to pilot test new definitions proposed in an OPS rulemaking that affects the pipeline industry.



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## ECOLOGICAL RISK ASSESSMENTS

*MFG staff have worked at the forefront of efforts to integrate ecological risk into surface water regulations and watershed-based regulatory approaches, as well as using ecological risk-based analysis to support our clients in a wide-variety of applications, such as remedial decision-making and Natural Resource Damage Assessment (NRDA).*

Environmental regulations increasingly allow use of risk-based environmental solutions. This is important because it allows environmental solutions to be specifically tailored to the problems and resources for a given site. As a result, remedies can be more effective and cost-efficient because sources of risk can be prioritized and resources focused on the greatest potential sources of risk.

Ecological risk assessment (ERA) is an important regulatory and scientific tool used in developing environmental solutions. ERAs often require a multidisciplinary approach including ecologists, toxicologists, geochemists, and other disciplines. MFG has extensive expertise in these fields, and experience working as a team toward risk-based solutions.

Ecological risk assessment evaluates the likelihood that adverse effects may occur, or are occurring, due to exposure to one or more stressors. Stressors include any chemical, physical, or biological factor that can induce adverse effects on receptors (e.g., individuals, populations, communities, or ecosystems). For a risk to potentially exist, the stressor must have the inherent capacity to cause one or more adverse effects to a receptor. Furthermore, potentially sensitive receptors must be exposed for sufficient durations and magnitudes to produce an ecologically significant effect. MFG scientists have the technical expertise and practical experience to design effective ERAs and solutions that match the resources and management goals of a site.

MFG is very experienced in using existing EPA and state guidance in conducting ERAs. If designed properly, risk assessments can help risk managers evaluate problems, establish priorities, and provide a scientific basis for decision-making. MFG staff's experience with ecological risk assessment and remediation includes:

- Conducting multi-media site-specific screening level and baseline ecological risk assessments for a wide variety of metals and organic compounds, including arsenic, chromium, mercury, lead, dioxins, explosives, PAHs, PCBs, pesticides, and radionuclides;
- Conducting watershed-based assessments to help clients prioritize threats to wetlands due to potential sources of pollutant discharge under varied land use;
- Conducting site-specific bioavailability/bioaccessibility assessments using concurrent geochemical analysis, toxicity testing, biological tissue analysis, and ecological characterization to determine acceptable clean-up criteria;
- Designing habitat restoration to reduce ecological risks to aquatic and terrestrial resources by reducing the bioavailability of various heavy metals;
- Developing site-specific water-effects ratios and geochemical translators to predict dissolved metal concentrations from raw solutions;
- Assessing a full range of alternatives to address concerns about risk potentials from cadmium, hexavalent chromium, arsenic, polonium-210, and fluoride in air, water, and soil pathways;
- Conducting baseline ERAs to address tailing deposition in water, sediment, and soils as well as using field trials to address phytotoxicity and alternative remediation; and
- Successfully negotiating with agencies to help focus risk assessment and risk management activities.



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## **ENVIRONMENTAL IMPACT ASSESSMENTS & STATEMENTS**

*MFG supports our clients' needs for new and expanding projects by providing both technical assistance and project management for the scoping, negotiation, preparation and defense of Environmental Impact Statements and other NEPA requirements.*

MFG staff and associates understand NEPA requirements through our experience in numerous projects involving various technical issues, complex report production, public meetings, workshops and other public participation activities.

Through our Environmental Impact Statement (EIS) projects we clearly explain the environmental impacts of the proposal and the alternatives, including clearly defined options from which to choose. In scoping and assessing the proposed action, other development alternatives, and the "no action" alternative, we consider direct, indirect, and cumulative impacts for each alternative. We also develop possible measures for mitigating any significant unavoidable environmental impacts and any appropriate monitoring efforts.

The following are a few examples of our team's considerable experience with NEPA requirements:

- MFG has held membership on the federal Council on Environmental Quality Legal Advisory Committee on NEPA implementation.
- A comprehensive environmental impact report was coordinated for BLM and Napa, Lake, and Yolo counties of California for a joint EIS and Environmental Impact Report (EIR) on the McLaughlin Project gold mine. The joint EIR/EIS complied with both NEPA and the California Environmental Quality Act (CEQA).
- We have supported "lead" agencies (i.e., Forest Service, BLM, DOE, Air Force) in conducting public and agency reviews of several EISs including organizing public participation formats and prepared response to public and agency comments on EISs.
- Impacts of mining sand and gravel from the creek bed of Cache Creek (Yolo County, CA) was assessed. This work, performed for a third-party task force, brought the aggregate industry and the farming interests together. Follow-up to this study involved the evaluation of the mining and reclamation plans for compliance with a county ordinance passed in response to earlier findings.
- We have acted as technical lead to assess select concerns for two USDA Forest Service and Montana Department of State Lands third-party EISs for two new proposed mines. The EISs required evaluating cumulative historical and projected new impacts, determining mitigation potentials, and developing monitoring plans.
- Project Management for an environmental siting and impact analysis of three alternative surface coal mining sites and nine alternative coal-to-gasoline (synfuel) plant sites in the Northern Great Plains was performed.
- Analysis and evaluations have been conducted regarding selected impacts related to several freeway projects; expansion of an existing sand and gravel extraction facility; construction and operation of an incinerator ash landfill; expansion of a municipal water supply reservoir; highway upgrades; and redevelopment of the former Lockheed Shipyard.



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## ***ENVIRONMENTAL SITE ASSESSMENT SERVICES***

*MFG has extensive experience performing environmental site assessments and compliance auditing.*

MFG professional staff has extensive experience in the area of environmental site assessment. Our clients include nationally recognized lending institutions, title insurance companies, law firms, asset management firms, and other parties involved in real estate transactions. MFG's environmental site assessments are completed in accordance with industry accepted ASTM standards and may be customized to better suit the specific needs of our clients. In order to better serve clients requiring environmental site assessment services, MFG designates personnel to maintain knowledge of client-specific assessment requirements and develop a system to complete assessments and generate reports in an efficient, cost-effective manner.

In addition, MFG staff has extensive experience in the identification and assessment of waste management problems associated with landfills, impoundments, and underground tanks and piping. MFG's experience and capabilities include geological and hydrogeological investigations; design and installation of groundwater monitoring programs; sampling of groundwater, surface water, soils, air, leachate and stream sediments; hydrogeologic and contaminant transport modeling; and waste characterization.

MFG staff has provided environmental site assessment services to the following types of businesses:

- Mining;
- Banking;
- Insurance;
- Real estate investment;
- Real estate development;
- Timber;
- Corporate and pension investment managers;
- Car rental;
- Light and heavy industrial manufacturing;
- Automotive industry;
- Law firms; and
- Telecommunications.

MFG's experience in environmental site assessment includes:

- Greenfield and Brownfield site evaluation;
- Portfolio services;
- Corporate due diligence assessments;
- Corporate acquisitions and divestitures;
- Litigation support; and
- Assessments of state and federally regulated oil and/or hazardous materials release sites.



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## **GEOGRAPHIC INFORMATION SYSTEMS**

*MFG produces environmental solutions by developing and applying Geographic Information Systems (GIS).*

MFG implements Geographic Information Systems (GIS) solutions for a wide variety of environmental problems. These systems facilitate data management, data analysis, and display of geographically-based information over landscapes of specific client concern. GIS is especially well suited for spatially complex sites and sites with large data sets.

Utilizing GIS is an efficient method for addressing many regulatory needs. For example, within a TMDL (total maximum daily load) framework, as defined by the Clean Water Act, GIS can help to identify and rank point source, nonpoint source, and habitat causes of impaired surface water uses. With this information, the technical basis for appropriate, cost-effective strategies to remedy impairments can be established.

GIS applications provide managers and technical personnel with data management tools to produce well-informed, rapid decisions. Many businesses, including the following, can benefit from GIS analysis:

- Mining;
- Oil and gas;
- Agriculture;
- NPDES permit holders;
- Ski areas, golf courses, and other resort operators;
- Manufacturing industries;
- Water districts; and
- Chemical manufacturing and processing industries.

To capture the benefits of GIS for our clients, MFG designs and constructs GIS databases. We complete data entry, conversion, and analysis and integrate models with GIS. We then produce high quality maps to aid in problem analysis, problem understanding, and problem resolution.

The georeferenced databases we produce for clients often integrate data from diverse sources. Source data can include information on land use, contaminant distributions, pollutant source locations and loads, groundwater depths, flow patterns, chemical concentrations, monitoring locations, historical trends, model projections, underlying geology, and topography. Once integrated, these data can be queried and evaluated based on either spatial or attribute (data) characteristics. All results can be reported using full-color maps.

Applications of GIS completed by MFG staff are exemplified by the following:

- Mine reclamation and waste rock placement designs, including volumetric calculations and site visualization;
- Environmental Impact Statements, including site-wide management of groundwater, surface water; soil and biotic sample data;
- Air quality modeling, including integrating multiple model scenarios from independent sources to estimate total exposure;
- Remedial investigations at former and active mine sites;
- Watershed modeling of land use and soil erosion and hydrologic processes; and
- Development of design for railroad conversion to recreational trail.



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## HUMAN HEALTH RISK ASSESSMENTS

*MFG uses human health risk assessment to help clients effectively address regulatory, industrial, and public health concerns.*

Risk-based approaches to problem solving have become the standard for industry and are gaining broader acceptance and use by many regulatory programs. As such, the need for risk assessment and risk-based approaches has increased in the past decade. MFG has considerable experience conducting multichemical, multipathway human health risk assessments. As a result of our practical experience implementing risk-based strategies under various regulatory programs, we have successfully negotiated cost-effective, innovative, and scientifically defensible solutions for environmental problems.

MFG staff have been involved with developing risk-based regulations for several regulatory programs and follow the evolution of risk-based methodologies for federal and state programs. When we can influence the process, we participate in stakeholder involvement initiatives and other public input activities. These endeavors keep us abreast of current regulatory developments and allow us to provide insightful recommendations to our clients.

MFG's multidisciplinary risk assessment team includes experts in toxicology, environmental fate and transport modeling, environmental sciences and engineering, hydrogeology, chemistry, and statistics. Our professionals have strong scientific capabilities and practical experience in completing human health risk assessments for chemicals in the environment, in the work place, as well as in foods, drugs, and other consumer products. MFG also has provided expert toxicological and risk assessment services for risk communications services (e.g., public education and meeting facilitation, and fact sheet preparation), and risk assessment policy analysis.

MFG staff's experience with human health risk assessment and risk-based approaches includes:

- Performing numerous human health risk assessments under CERCLA, RCRA, and state programs to identify risk drivers;
- Using risk-based approaches in remedy selection to characterize appropriate response actions, negotiate with regulatory agencies to incorporate reasonable risk practices into agency-led evaluations, develop risk reduction/cost evaluations, and prioritize site activities;
- Conducting sophisticated statistical modeling to estimate exposure point concentrations for risk assessments and to demonstrate compliance with risk-based standards and response action objectives;
- Critically reviewing and evaluating toxicological data in support of the High Production Volume Chemical Challenge, toxic tort litigation, TSCA evaluations, MSDS preparation, community right-to-know programs, and other regulatory initiatives;
- Providing risk policy and regulatory analysis for our clients by formal comments on rule-making initiatives, participating in guidance development to advocate the use of scientifically defensible risk assessment practices, and evaluating potential site-specific impacts risk regulations may have at a site, and;
- Understanding and using the Risk-Based Corrective Action (RBCA) process that is generally the standard for evaluating potential impacts and risks from leaking petroleum storage tank sites.





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## LANDFILL SERVICES

*MFG offers a full range of engineering and scientific services addressing industrial, special purpose, and municipal landfill needs.*

MFG provides professional consulting to a wide variety of landfill owners and operators across the country. Because our individual offices collaborate on projects, our staff has experience in many different jurisdictions. We use that experience to apply proven solutions to new situations, bring the latest technology to our clients, and enlighten regulators as to alternative cost-effective methods.

We provide expertise in the following typical components of a landfill development project:

- Siting and permitting;
- Landfill planning;
- Engineering design;
- Construction management;
- Leachate management;
- Landfill gas management;
- Storm water management;
- Landfill closure;
- Operations and monitoring;
- Closure design; and
- Post-closure planning.

MFG's staff experience includes the following project examples:

- Hydrogeologic and geotechnical investigations in support of Waste Management of North America's existing 122-acre landfill and proposed 80-acre expansion in Williamson County, Texas;
- Field work, RI/FS work plan, and interim remedial measures for GBF/Pittsburg Landfill in Contra Costa County, California;
- Comprehensive hydrogeologic investigation of Laidlaw's 280-acre industrial treatment, storage, and disposal facility and adjacent 220-acre municipal landfill in Colorado County Texas;
- Hydrogeologic and geotechnical evaluation and closure planning for the Caney Branch Ash Landfill in Panola County, Texas;
- Permitting, design, and construction management of a 15-acre expansion of the Hidden Valley Landfill in Pierce County, Washington;
- Operation and maintenance plan for the Coffin Butte Landfill in Benton County, Oregon;
- Permitting, design, and construction management of the 33-acre City of Copperas Cove, Texas Type I Subtitle D including a 360,000 gallon leachate storage facility;
- Evaluation of historical wood waste landfills for possible remediation cost risks for a major wood products manufacturer;
- Installation and operation of a meteorological station to evaluate odor complaints regarding the Cedar Hills Regional Landfill in King County, Washington; and
- Evaluation of odors and airborne toxic from a major municipal solid waste landfill for the City of Mountain View, California.



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## LEGAL SUPPORT

*MFG works closely with clients and/or their attorneys to prepare accurate and defensible technical evaluations, provide expert reports and testimony, and critically evaluate reports and testimony provided by other experts.*

The identification of contamination at a site often results in the need for appropriate cost allocation of the attendant investigation and cleanup costs. In such cases, MFG works closely with clients and/or their attorneys to prepare accurate and defensible technical evaluations of the issues in question, provide expert reports and testimony, and critically evaluate reports and testimony provided by other experts. Our clients particularly appreciate our attention to detail and our technically sound, yet creative, approach to bringing our expertise to bear on key issues.

In cases where the divisibility of costs is in question, MFG has combined various scientific methodologies to produce innovative assessments of the divisibility of damages to soil and water resources. The relative contribution of various sources of environmental degradation can often be identified by a variety of physical, chemical, biological and isotopic techniques. Knowledge of the rates of contaminant migration and their transformation through time, in concert with diligent review of historical records, can be used to ascertain whether natural resources damages are chronologically divisible (see for example the attached project description entitled "Assessments of Culpability for Cleanup of Dissolved- and Free-Phase Hydrocarbons at a Multi-Owner Refinery Complex." MFG also has experience in developing models describing source culpability and has been able to successfully create cost allocation schemes based on a comprehensive technical approach.

MFG's experience in providing legal support services include:

- Developing remediation cost estimates for 22 former industrial (coal gasification) sites to be used in insurance negotiations;
- Providing expert testimony and technical support during insurance litigation related to cost

recovery actions for the Bunker Hill Superfund site;

- Assessing culpability for cleanup of dissolved- and free-phase hydrocarbons at a multi-owner refinery complex;
- Providing bankruptcy litigation support and corrective plan development for a former food processing plant;
- Using fuel fingerprinting and contaminant transport pathway analysis to evaluate whether a particular pipeline and bulk fuel terminal operator at a port in Central California had contributed to a groundwater contamination plume;
- Providing litigation support and expert testimony regarding a tank that ruptured during demolition of a dry cleaning facility and whether this tank contributed to contamination present at the site;
- Preparing natural resource damage assessments (NRDAs) for a large mining Superfund site and downstream watershed areas, and for a Superfund site comprising a 3,500-acre operational facility and adjacent marine habitat;
- Providing technical and litigation support to two major mining companies in separate cases regarding violations of the Clean Water Act alleged by consortiums of citizen's groups;
- Evaluating the source and release date of an extensive trichloromethane (TCE) groundwater plume originating from a manufacturing facility historically used by several different entities; and
- Litigation support and expert testimony regarding liability and cost allocation under CERCLA, consistency with the National Contingency Plan and environmental damages.



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## NATURAL RESOURCE DAMAGE ASSESSMENTS

*MFG provides Natural Resource Damage litigation support and accurate evaluation of injury based on technical assessments of existing and potential resource conditions in stream, river, lake, reservoir, groundwater, wetland, riparian, and upland habitats of concern.*

MFG provides Natural Resource Damage Assessments (NRDA) support to potentially responsible parties based on an accurate evaluation of injury and the affects of any identified injuries on uses and services. MFG has conducted technical assessments of existing and potential resource conditions in stream, river, lake, reservoir, groundwater, wetland, riparian, coastal and upland habitats.

MFG has technical staff with experience in developing restoration plans, negotiating, and settling claims for natural resource damage. We have worked at mining and mineral processing areas, industrial sites with synthetic compounds, and refineries with petroleum products and byproducts. Our combined experience includes a broad geographic range of ecosystems.

Our projects have included cooperative efforts, work in support of CERCLA and NRDA litigation, and restoration work funded by NRDA settlements. We have spearheaded watershed-scale planning, implementation, and negotiation efforts using cost-effective GIS technology. Our restoration designs emphasize practical measures focused on the cost-efficiencies of enhanced natural recovery.

MFG has developed models describing chronological divisibility and source culpability and has successfully created cost allocation schemes based on comprehensive technical approaches.

We have assisted clients with NRDA issues at major Superfund sites and a number of smaller cleanup sites in the central and western United States, including:

- *Bunker Hill Superfund Site*, the nation's second largest Superfund site by area, where MFG's staff directed the Remedial Investigation/Feasibility Study (RI/FS). Currently, MFG is the lead technical consultant supporting the mining companies defense against extensive NRDA claims for the Coeur d'Alene River Basin. These claims are being brought by the USDOJ on behalf of a number of Federal and Tribal Trustees. MFG has also assisted Union Pacific Railroad with a settlement on NRDA liability within the Coeur d'Alene River Basin.
- *Alcoa Point Comfort/Lavaca Bay Superfund Site*, where MFG has provided technical support in a cooperative agreement between Alcoa and the Trustees in which NRDA information requirements are being integrated with a concurrent RI/FS process.
- *Tri-States Mining District*, where MFG is assisting with the integration of restoration planning into a Feasibility Study being conducted for remediation of mining wastes within the Jasper County NPL site. MFG is working with Federal and State Trustees as well as EPA to outline and implement a process to assure that the remedy selection process also addresses restoration to the extent practicable.
- *Portland Harbor, Oregon*, where MFG is providing technical support to the Port of Portland concerning development and implementation of a cooperative process with the natural resource Trustees that would integrate NRDA data collection with a simultaneous RI/FS process.



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## ***POLLUTION PREVENTION AND COMPLIANCE***

*MFG helps our many clients meet environmental compliance and pollution prevention requirements.*

MFG assists clients with pollution prevention and environmental compliance efforts by reviewing facility environmental compliance procedures, by proposing operational modifications to reduce toxic chemical use and waste, and by educating clients in the effective management of generated wastes. We understand the environmental compliance and pollution prevention needs of our clients. Many of our staff have consulted extensively with industrial clients and many previously have been directly employed in industry.

Our services often lead to production and waste disposal cost savings for clients, as well as cleaner and safer facilities. Many types of businesses have benefited from our pollution prevention and environmental compliance services:

- Mining;
- Agriculture;
- Metals refining operations;
- Car rental companies;
- Food processing facilities;
- Seaport districts;
- Petroleum storage and distribution facilities;
- School districts and municipalities;

- Chemical manufacturing and processing industries; and
- Heavy and light manufacturing industries.

MFG's services in environmental compliance and pollution prevention include:

- Developing facility and corporate-wide environmental management strategies and programs;
- Completing environmental compliance audits;
- Assessing Clean Air Act compliance for emission controls, air quality, noise, and odors;
- Reporting chemical storage, use, treatment, and disposal activities under RCRA, SARA and TSCA;
- Managing hazardous waste and hazardous materials to achieve compliance under the Uniform Fire Code;
- Developing hazardous waste management plans;
- Preparing NPDES discharge permits and stormwater pollution prevention plans; and
- Preparing spill prevention, control and countermeasure (SPCC) plans.



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## REGULATORY ASSISTANCE

*MFG provides experienced assistance with the often complex regulatory processes of obtaining federal, state and local permits, negotiating standards, and determining closure requirements.*

MFG has considerable experience in assisting clients in cost-effectively meeting regulatory requirements. We have performed regulatory assistance services under CERCLA, RCRA, CWA and state environmental regulatory programs. MFG staff have prepared reports for or provided testimony to many federal and state agencies:

- US Army Corps of Engineers;
- US Department of Energy;
- US Environmental Protection Agency;
- US Nuclear Regulatory Commission;
- USDA, Forest Service;
- USDI, Bureau of Land Management;
- USDI, Bureau of Reclamation;
- USDI, Fish and Wildlife Service;
- USDI, Geological Survey;
- Alaska Department of Environmental Conservation;
- Alaska Department of Fish and Game;
- Arizona Department of Environmental Quality;
- California Department of Toxic Substances Control;
- California Regional Water Quality Control Boards;
- California State Water Resources Control Board;
- California Division of Forestry;
- Colorado Department of Labor and Employment, Oil Inspection Section;
- Colorado Department of Natural Resources Oil & Gas Conservation Commission;
- Colorado Department of Public Health and Environment;
- Colorado Division of Wildlife;
- Colorado Office of the Attorney General;
- Delaware Department of Natural Resources and Environmental Control;
- Idaho Department of Health and Welfare;
- Massachusetts Department of Environmental Protection;
- Montana Department of State Lands;
- Montana Department of Natural Resources and Conservation;
- Nebraska Department of Water Resources;
- New Hampshire Department of Environmental Services;
- New Mexico State Engineer Office;
- Oregon Department of Environmental Quality;
- Texas Water Commission;
- Texas Department of Health;
- Texas Natural Resource Conservation Commission;
- Texas Railroad Commission;
- Utah Geological and Mineralogical Survey;
- Washington Department of Ecology;
- Wyoming Department of Environmental Quality;
- Wyoming Department of Transportation; and
- Wyoming Game and Fish Department.



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## **SITE INVESTIGATIONS AND ASSESSMENTS**

*MFG has extensive experience conducting site assessments involving the analysis of soil, sediment, groundwater, surface water, and air to evaluate environmental conditions associated with both ongoing and historical site use.*

MFG's experience and capabilities include geological and hydrogeological investigations; design and execution of monitoring programs for groundwater, surface water, soil, air, leachate, and stream sediment; hydrogeologic and contaminant transport modeling; characterization of wastes; and analysis of chemical and biological samples. Our staff has solid practical knowledge of EPA analytical protocols for priority pollutant analyses, standard water and wastewater analyses, and physical characterization of air and subsurface media. We strive to be cost effective and innovative by combining, when possible, assessment activities with feasibility and pilot studies. We maintain a problem-solving attitude by identifying and focusing our attention on significant project issues, which are often tied to regulatory needs and acceptance.

MFG has combined various scientific approaches to produce efficient, innovative assessments of affected soil, sediment, groundwater, and surface water resources. The relative contribution from various sources of environmental degradation can often be identified by combining physical, chemical, biological, and isotopic techniques. Using contaminant transformation rates and geologic dating techniques, combined with a diligent review of historical records, MFG can provide useful assessments of whether the site contamination and/or its consequential natural resource damages are chronologically or spatially divisible.

MFG's experience in environmental site assessment includes:

- Performing multiple-phased, complex investigations involving soil, sediment, groundwater, surface water and air;
- Designing and implementing groundwater, surface water and vadose zone monitoring programs, including the use of computerized data-logging equipment;
- Modeling groundwater flow regimes and contaminant transport;
- Conducting subsurface geophysical and soil gas investigations;
- Using chemical "fingerprints" to trace the origin and estimated age of hydrocarbon contamination in groundwater;
- Measuring the stable isotopes of hydrogen, oxygen and radioactive tritium to discern the amount of source-related contamination versus naturally elevated conditions; and
- Evaluating the integrity and hydrologic effectiveness of natural- and synthetic-engineered barriers to flow, including slurry walls, interceptor trenches, liners, and caps.



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## **SOLID WASTE MANAGEMENT**

*MFG offers a full range of engineering, economic, and scientific services assisting private industry and public organizations manage their waste.*

MFG's professional and technical staff education and experience includes agriculture; biomedical science; chemical, civil, environmental, mechanical, mining, engineering; environmental science; geology; hydrogeology; microbiology; limnology; oceanography; soil science; toxicology; and zoology. We have addressed client needs managing a wide range of waste streams and problems, from acidic wastes to synthetic organic compounds, from compost facility odor to underground storage tank releases, and from hydrogeologic investigation to landfill gas permitting.

MFG has provided a variety of services for a range of landfills and transfer stations across the United States. Project examples include:

- Title V air quality permit for Regional Disposal Co.'s Roosevelt, Washington Landfill in which MFG addressed the potential change in emissions due to future leachate recirculation and was successful in having the application ruled complete on the day of submission by working closely with Department of Ecology;
- Environmental noise analysis for Snohomish County's Southwest Recycling and Transfer Station for which ongoing work includes measurement and analysis of sound levels under existing and early morning conditions and recommendations for mitigation measures;
- Federal Operating Permit for Beaver Hill Solid Waste Incinerator in Coos County, Oregon for which MFG prepared a comprehensive emission inventory, review of

engineering design plans for plant upgrades, and completion of application forms;

- Hydrogeologic evaluation, characterization, and long term monitoring for a RCRA Subtitle C TSD Facility in Eastern Colorado;
- Groundwater assessment for the Gary Air Force Base Landfill in San Marcos, Texas; and
- Comprehensive site monitoring program for the City of Albany, California's landfill.

MFG's staff are also well qualified to perform a variety of modeling of air, noise, contaminant fate and transport, groundwater, and storm water for waste facilities using simple and complex models such as:

- HELP;
- PLUME2D;
- MEMO;
- LANDFILL2;
- Visual MODFLOW;
- MT3D;
- PRINCE;
- FLOWPATH; and
- MULTIMED.



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## STORAGE TANK SYSTEMS

*MFG provides the expertise required for the removal and closure of problem storage tanks and related services.*

MFG staff has worked on more than 50 projects involving removal and closure of tanks under CERCLA and RCRA and state regulatory authority. Our staff provide private and municipal clients with closure and related services for both above ground and below ground tanks containing gasoline, diesel, fuel oil, aviation fuels, chlorinated solvents, methanol, standard solvent, and tetrahydrofuran.

MFG provides effective oversight and sampling services following strict standard operating procedures, as required by local, state, and federal regulations. We understand and follow local requirements, building codes, fire codes, air pollution control requirements and surface drainage requirements to facilitate tank removal and new system designs most appropriate to address present and future needs of clients.

MFG coordinates closely with clients during tank removal and/or new tank placement to develop timely solutions to any problems and to minimize disruption of ongoing business operations. We can schedule on-site work activities to meet client needs, conduct work during off-hours, or direct certain project activities to off-site locations.

MFG has completed complex tank removals in close proximity to existing structures and utility facilities, and in unfavorable soil and groundwater conditions. Our experience has been instrumental in maintaining the integrity of existing structures during tank removal. Where appropriate, we have completed in-place tank closures in conjunction with agency negotiation.

Our tank related work has included:

- Coordination and oversight of tank removal and/or in-place closure activities, including overexcavation and disposal of contaminated soil;
- Collection and submittal of confirmation samples to evaluate compliance with regulatory cleanup requirements;
- Site characterization and contaminant delineation;
- Fuel fingerprinting and chromatogram analysis to assess product composition, source and age;
- Fate and transport modeling to support risk assessments and remedial system design;
- Technological and economic feasibility evaluations of remedial alternatives, and preparation of Corrective Action Plans;
- Design, installation, operation and maintenance of remedial systems, including passive and active NAPL extraction, groundwater extraction and treatment, vapor extraction, air sparging, in situ chemical oxidation (such as oxygen releasing compound and hydrogen peroxide), and in situ and ex situ bioremediation;
- Monitoring of remediation progress including evaluations of remediation system monitoring data to assess contaminant removal, and sampling of groundwater, soil and soil vapor (respirometry testing);
- Preparation of No Further Action justifications/closure reports; and
- Technical justifications for cost reimbursement and/or allocation.





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## ***SURFACE WATER DISCHARGE PERMITS***

*MFG has successfully prepared and negotiated federal, state, and municipal permit applications for wastewater and stormwater discharges and for discharge modifications for industry, mining facilities, and Publicly Owned Treatment Works (POTWs) in sixteen states.*

MFG has aided clients with all aspects of federal and state National Pollutant Discharge Elimination System (NPDES) and stormwater discharge permitting. We have prepared NPDES wastewater and stormwater discharge permit applications for a variety of industrial manufacturing, mining, and municipal facilities. Our experience negotiating permit conditions and limitations has included evaluating best available treatment technologies applicable for discharges and evaluating the water quality standards applied to defined receiving water uses and providing technical support for changes on stream standards and classifications for receiving waters. We have prepared pre-treatment permit applications and conducted permit negotiation for a variety of industrial and mining clients. MFG's past services to clients include:

- Wastewater and stormwater compliance audits for industrial facilities;
- Design and implementation of NPDES monitoring programs, including surface water, wastewater, stormwater, and sediment sampling and analysis;
- Preparation of Stormwater Pollution Prevention Plans;
- Permitting the discharge of treated groundwater;
- Water discharge data management and evaluation;
- Completion of waste load allocation (WLA) studies under the total maximum daily load (TMDL) framework;
- Surface water modeling to support NPDES permit applications;

- Preparing Spill Prevention Control and Countermeasure (SPCC) Plans;
- Management of Toxicity Reduction Evaluations (TREs) and Toxicity Identification Evaluations (TIEs); and
- Testimony regarding changes to stream standards and classifications.

Representative projects completed by MFG include:

- Reviewed an NPDES permit application and supporting materials for a north-central Nevada mine to evaluate whether a potential discharge of approximately 70,000 gpm from mine dewatering would meet pollutant and temperature limits in the receiving water;
- Prepared a successful NPDES permit application for a manufacturing company in Santa Clara, California to discharge extracted groundwater into a public storm drain after treatment to remove VOCs;
- Evaluated the potential benefits of alternative analytical methods for effluents (total recoverable versus the potentially dissolved method) in the amended water quality standards for trace metals on the NPDES permit for the Louisville (Colorado) Wastewater Treatment Plant; and
- Provided written and oral testimony to support changes to stream standards and classifications for mining-impacted stream segments in the Rio Grande and Arkansas River Basins of Colorado, as well as state-wide basic stream standards.



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## ***UAA'S AND SITE-SPECIFIC STANDARD DEVELOPMENT***

*MFG is experienced in conducting use attainability analyses (UAA) and developing site-specific stream standards which are effectively implemented through coordination and negotiation with state and federal regulators.*

Designated uses assigned to a waterbody may be based on information collected for the purpose of use designation or, in the absence of data, on conservative assumptions about the potential uses of the waterbody. When designated uses are attained but stream standards are not, numeric criteria may be modified and site-specific standards may be developed. Because national criteria are based primarily on laboratory studies representing a limited range of conditions, these criteria often do not adequately represent chemical, physical, or biological attributes of specific regional waters. Therefore, EPA provides procedures for criteria modification and site-specific standard development.

The staff of MFG have extensive experience in designing, conducting, and managing studies to evaluate proposed and existing designated uses for receiving waters. Further, MFG personnel have developed and managed site-specific standard and criteria modification studies for clients using the EPA recommended procedures. Similarly, MFG staff have conducted special studies and negotiated with state and federal regulators to develop and effectively implement site-specific stream standards when conventional methods were inadequate or inappropriate for site-specific standard development.

MFG's past services to clients include:

- Developing and implementing chemical, physical, and biological studies for receiving waters UAAs;
- Providing critical evaluations of data to assess proposed designated uses;

- Designing systematic protocols and alternative strategies to develop site-specific standards and criteria;
- Recalculating ambient water quality criteria;
- Providing client negotiation support for UAAs, use, and standards definitions; and
- Testifying to support changes in stream standards and classifications.

Representative projects include:

- Conducted a risk-based evaluation in lieu of removing a fish consumption use. The evaluation resulted in an increase in a stream's arsenic standard for a large copper mining complex in Arizona.
- Provided written and oral testimony to support changing stream classifications and standards for stream segments in Colorado's Rio Grande and Animas River basins, and to support changes to state-wide stream standards.
- Conducted a 2-year long field and laboratory study for Denver's WWTP to support site-specific DO standards for early life-stage and older life-stages for the South Platte.
- Conducted phased studies to support a site-specific copper standard for a small Arizona municipal WWTP that included metal translators, WERs, TMDLs, recalculation procedure, resident species procedure, risk analysis, and ecological benefits. State and federal negotiations led to using a weight-of-evidence approach to justify a new standard.



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## WATER SUPPLY SERVICE

*MFG offers a wide range of professional consulting services for the exploration, development, management and treatment of groundwater and surface water resources. These services are provided in the context of environmental investigation and remedial actions, programs to facilitate extraction of mineral resources, water rights and appropriations, as well as more conventional water supply applications.*

MFG's professional and technical staff capabilities include evaluation and design of:

- Water treatment systems;
- Storage and distribution systems;
- Dewatering and depressurization; and
- Hydraulic containment.

MFG's staff capabilities also include:

- Groundwater resource evaluation;
- Water well siting;
- Well field optimization;
- Well integrity evaluation;
- Conjunctive use studies;
- Streamflow and reservoir routing; and
- Water resource planning studies

MFG staff has provided a variety of water resource services for a range of clients. Selected projects include:

- Rehabilitation of Golden Gate Park's irrigation wells for the City of San Francisco, California, which culminated in siting, design, and installation of two new production wells, selection, and mechanical and electrical design.
- Feasibility study for developing groundwater resources to serve a residential development and golf course, which included drilling 45 test holes, installing 17 piezometers, testing

the aquifer in three locations, and estimating the minimum perennial yield for each aquifer.

- Well siting and estimation of long-term performance for a residential development in Boerne, Texas, where well yields were optimized by delineating lineaments during siting.
- Design of a 2,000 gpm packed tower aeration system to treat TCE and EDB near an aerospace manufacturing facility in New York. Services included pilot testing, plans and specifications, evaluation of air emissions, and negotiation of regulatory approval.
- Design of a 2 million gallon water storage tank and 4.8 MGD pumping system for Cincinnati Water Works in Ohio.
- Comprehensive evaluation of water resources in New Castle County, Delaware for EPA which included assessment of impacts from land disposal of municipal and industrial wastes, quantification of current and potential groundwater and surface water resources, and current and future water demand.
- Assessment of the proposed annual diversion of 134,000 acre-feet of water from the Platte River near Chapman, Nebraska, where a separate groundwater model was prepared to quantify the effects on small municipal well fields adjacent to this reach of the river.



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## WATERSHED ANALYSIS AND PLANNING

*MFG assists private and municipal sector clients in benefiting from the regulatory, economic, environmental, and public relationship advantages of cooperative watershed-scale monitoring, planning, and management.*

MFG has broad experience in watershed-based approaches. Watershed-based approaches for regulating water quality can be cost-effective relative to the more traditional site-specific approaches. Savings come from integrating monitoring programs conducted by stakeholder consortiums, using risk-based solutions to set priorities for solving water quality problems, facilitating greater permitting efficiencies within regulatory agencies, and developing innovative ways to meet water quality goals, including habitat enhancement and pollutant trading.

MFG helps clients develop cost-effective solutions to meet water quality goals and related natural resource analysis, protection, and restoration requirements. Our services include:

- Assessing opportunities for pollutant trading and habitat restoration;
- Performing feasibility analyses of alternatives; designing and implementing effluent control and treatment systems;
- Applying risk-based solutions to determine reasonable permit limits to meet water quality goals;
- Designing, coordinating, and implementing integrated monitoring programs; and
- Project management, including coordinating permitting for diverse regulatory requirements and program goals.

Representative MFG project experience includes:

- *Humboldt County, Northern California* - MFG is currently performing watershed analyses studies for Pacific Lumber Company as required by the Habitat Conservation Plan for approximately 210,000 acres of Redwood and Douglas Fir forest in Humboldt County, Northern California. Protocol will follow a modified version of the Washington Forest Practices Board Manual Standard

Methodology for Conducting Watershed Analysis (WDNR Methodology), and requires in depth evaluation of mass wasting, surface erosion, hydrology, riparian function, fish and amphibian habitat, channel condition, and cumulative effects in each watershed. Watershed analyses will be used to develop site specific forest harvest prescriptions that are protective of watershed resources including federally threatened salmon species.

- *Willow Creek Reclamation Committee, CO* - Consultant selected by the WCRC to summarize and characterize the watershed condition based on the quality and availability of existing data; develop a watershed database; develop required site studies to evaluate remediation efforts related to control of specific point and non-point source metals loads; train sampling volunteers; coordinate and participate in surface water and groundwater quality sampling and baseline biological assessment; and identify and develop funding sources to implement proposed characterization and remedial activities. MFG wrote and supported the first two CSA Section 319 funding proposals accepted by both the State and EPA. Funding through this process allowed for completion of the first phase of an intensive and focused low flow watershed characterization in Fall of 1999.
- *Bonanza Mining District, CO* - Facilitated development of active stakeholder group; designed and implemented stream-riparian restoration plan.
- *Panoche/Silver Creek, CA* - Assessment of factors influencing rates and magnitudes of sediment delivery in the watershed; development and evaluation of BMPs to control problems; coordination of efforts with the watershed's stakeholder planning group.





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## AIR QUALITY STUDIES

*MFG has successfully performed many air quality studies, as well as air quality and meteorological monitoring, in support of air quality permits, environmental impact assessments, and evaluations of air pollution control requirements.*

MFG staff include senior air quality specialists with extensive experience providing air quality consulting services to industry and government. These senior staff are supported by project-level and staff-level scientists and engineers with capabilities that encompass the entire range of air quality services.

Our staff has conducted and managed numerous investigations for all types of air pollution sources, including electric generating stations, pulp and paper mills, mining and smelting operations, manufacturing plants, vehicular traffic and other mobile sources, and large municipal facilities such as landfills and wastewater treatment plants. We have been retained as air quality experts by organizations including the American Mining Congress, the Electric Power Research Institute, the American Petroleum Institute, and the Environmental Protection Agency.

MFG's experience and capabilities in air quality studies include:

- Air quality permitting at the Federal, State and local level;
- Air quality modeling studies of all types;
- Development of air quality models for regulatory and research applications;
- Air quality and meteorological measurement programs;
- Preparation of emission inventories;

- Preparation of air pollution control technology review documents including BACT and LAER Assessments;
- Compliance order/consent order resolution;
- Odor and noise assessment and evaluation;
- Specialized air quality studies such as highway tunnel investigations; and
- Expert witness testimony on air quality.

Our air quality modeling experience has addressed issues including:

- Mobile source impacts;
- Prevention of Significant Deterioration (PSD) permits;
- State Implementation Plans (SIP);
- Photochemical oxidant assessments for urban airsheds and individual facilities;
- Visibility degradation;
- Health risk assessments and risk management prevention plans for accidental releases of acutely hazardous materials;
- Long-range transport studies;
- Remedial Investigations/Feasibility Studies (RI/FS); and
- Odor impact evaluations.



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## **BIOASSESSMENT AND BIOMONITORING**

*MFG provides expert services for conducting and managing bioassessments and biomonitoring in streams, rivers, lakes, and reservoirs.*

**Bioassessment** - Increasingly, states are developing requirements to meet narrative and numeric standards to address biological integrity, as required under the Clean Water Act. In turn, many NPDES permits are requiring joint assessments of ambient chemical water quality with biological and physical habitat quality. MFG's staff is experienced in developing, planning, and conducting these required assessments.

**Biomonitoring** - Whole effluent toxicity (WET) limits have long been a part of many NPDES permits. Accurate data and correct interpretation can mean the difference between meeting and failing permit limits. Failure may result in requirements for accelerated testing or trigger costly Toxicity Identification Evaluations (TIEs) and Toxicity Reduction Evaluations (TREs). MFG personnel have extensive experience in designing, conducting, and managing biomonitoring and bioassessment studies in support of or as compliance mechanisms for Clean Water Act issues. Importantly, MFG's staff is experienced in assessing test results for validity and accuracy.

Services provided by MFG staff include:

- Developing and implementing annual bioassessment plans for streams and riparian communities;
- Designing bioassessment strategies for integrated stormwater monitoring;
- Assessing physical habitat of receiving waters;
- Collecting and analyzing samples of fish, benthic macroinvertebrates, algae and sediments;
- Assessing candidate, threatened and endangered species status and their habitats;
- Auditing and selecting laboratories for aquatic toxicity testing;
- Collecting acute and chronic laboratory toxicity data to screen hazardous waste toxicity, and to assess WET limits and ambient and *in situ* toxicity; and
- Performing TREs and TIEs.

Our representative project experience includes:

- Development, implementation, and evaluation of annual receiving water bioassessments for a large copper mining complex in Arizona;
- Under NEPA, evaluation of potential impacts from water storage projects in northwest Wyoming, including evaluations of potential impacts to T&E species and to other downstream communities;
- Hazardous waste toxicity screenings and a biological assessment for a tailings dam failure into a nearby stream;
- Evaluating chemical properties and TIE results to assess whether repeated WET test failures of a treated mine effluent were due to chemical toxicity or precipitation;
- Design of a special study for a mining group to assess the potential for reducing the toxicity of discharged metals in very hard water; and
- Preparation of expert technical comments on draft guidance for conducting and interpreting aquatic monitoring data under Environment Canada's new discharge regulations for the pulp and paper industry.



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## ***DEEP WELL DESIGN AND INSTALLATION***

*MFG has extensive experience in the design and installation of deep wells for groundwater monitoring programs, resource development, and water supply.*

MFG staff provide design and installation services for deep wells. We are also experienced with testing and repair of injection disposal wells; packer testing; oil and gas well planning; well design, drilling, completion, and operations; formation testing and simulation techniques; oil and gas well repair and workover techniques; and design and construction of surface equipment, pipelines, and production facilities.

Specific MFG experience in designing and installing deep wells includes:

- A 940-foot deep water supply well to serve as a replacement for two existing industrial wells in California;
- A 500-foot deep monitoring well at the Intersil/Siemens Superfund (NPL) site in California;
- Several deep (300+ feet) monitoring wells at the Petroleum Waste Incorporated Lokern Facility in California;
- Four deep (300+ feet) stratigraphic coreholes located near a state Superfund site in Contra Costa County, California;
- Supervision of the construction and testing of deep municipal water supply wells in California and Arizona; and
- Supervision and installation of large diameter monitoring wells to meet monitoring requirements for deep injection wells at industrial and chemical refinery/process facilities on the Gulf Coast.





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## ENVIRONMENTAL NOISE

*MFG can evaluate a wide variety of environmental noise sources and situations, as required to assess environmental impacts, evaluate project designs and mitigation potentials, and projected compliance with regulations and permit conditions.*

MFG staff has extensive experience and expertise in measuring and assessing environmental noise. Type I and Type II sound level meters and octave band analyzers are used to characterize and evaluate environmental noise impacts.

We have produced computer analyses for a wide variety of noise sources and situations. Our experience modeling environmental noise includes evaluating noise transmission from transportation and industrial sources; applying the enhanced version of the Federal Highway Administration's traffic noise modeling system (STAMINA/OPTIMA); evaluating airport noise using the Federal Aviation Administration's Integrated Noise Model; evaluating point source noise transmission and attenuation; and evaluating the impacts of meteorology, ground effects, and topography on long-range environmental noise attenuation.

We also can assess environmental vibrations. Using a seismic accelerometer, MFG scientists measure low-frequency vibration due to such sources as traffic, trains and construction equipment. The measured vibration is assessed by comparison with established criteria.

MFG's staff has evaluated the consequences of noise from concrete and asphalt batch plants, fossil-fuel fired power plants, coal mines, sand and gravel quarries, city-wide alternative transportation plans, solid waste transfer stations, landfills, incinerators, electrical substations, new and modified roadways, and a variety of export facilities. Our other experience and capabilities in environmental noise include:

- Ambient noise measurement and measurement of noise source levels;

- Preparation of noise sections for NEPA and State Environmental Impact Statements;
- Design of noise mitigation measures, including sound barriers;
- Development of noise policies for regulatory applications;
- Specialized noise studies;
- Ground vibration measurement; and
- Expert witness testimony on environmental noise.

Specific projects include:

- Evaluation of noise implications associated with a sand and gravel processing plant expansion in Whatcom County, Washington;
- Air quality and noise evaluation of five potential sites for a simple-cycle combustion turbine project in Seattle, Washington;
- Noise compliance monitoring evaluation for Port of Seattle Terminal 90/91 in Seattle, Washington;
- Development of a road noise impact and mitigation policy for King County, Washington; and
- Environmental noise implications of a new interchange in Lynnwood, Washington.



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## ***EROSION ASSESSMENT AND CONTROL***

*MFG provides erosion assessment of disturbed and undisturbed lands and implements remedial measures for minimization of soil loss. Evaluation of existing and post-remedial conditions is conducted using a variety of modeling and physical assessment techniques.*

MFG staff have developed and implemented erosion assessment work plans for evaluation of interrill, rill, and gully erosion. These assessments have addressed the effects of forest, agricultural, and industrial/urban land uses. Often, these evaluations have been coupled with reclamation efforts on disturbed lands to achieve a stable terrestrial system. MFG evaluates existing and baseline conditions of erosion potential. Design conditions which may include implementation of various best management practices (BMPs) are also evaluated for erosion potential. BMPs include riparian zone development, check dams, grade control structures, in-line sedimentation retention areas, grazing mulch cover requirements, streambed stabilization facilities, channel bank stabilization measures; and vegetation establishment. Along with assessment, MFG provides design, construction oversight, and technical support for implementation of erosion control measures.

Evaluation activities typically involve a combination of field measurement and verification, as necessary, along with application of an appropriate erosion model to existing and post-remedial conditions. Models utilized by MFG staff include the Universal Soil Loss Equation (USLE), the Modified USLE (MUSLE), the Revised USLE (RUSLE), and the Water Erosion Prediction Project (WEPP) model. MFG personnel have investigated the application of the MUSLE and WEPP models to different university research projects which have involved comparisons of model runoff and soil loss estimates with corresponding measured data.

Examples of specific assignments related to erosion assessment and control include:

- Developing and implementing an erosion assessment plan in a steep, mountainous, highly eroded area that involved interrill, rill, and gully erosion evaluation and BMP recommendation;
- Modeling of historical gully development, prediction of long-term effects, and recommendation of remedial actions such as headcut control;
- Monitoring of runoff hydrographs and collection of runoff samples for analysis of sediment and nutrient loading; and comparison of measured data with model estimates for runoff and soil loss;
- Investigating contaminant enrichment of sediment during runoff/erosion events;
- Planning and developing riparian zones for streambank stabilization and upland sediment delivery control;
- Planting vegetation for upland erosion control; and
- Designing and constructing streambank and streambed stabilization facilities.

## MANAGEMENT AND RESTORATION OF LAKES, STREAMS AND RESERVOIRS



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*MFG has extensive experience in the assessment, management, and restoration of aquatic systems.*

MFG staff have worked in assessing, managing, and restoring fisheries and aquatic habitats since the 1970s. Our expertise stems from academic and private firm experience conducted in both the eastern and western United States. We have applied state-of-the-science knowledge and cost-effective approaches to develop and implement management, restoration, and mitigation plans. Our project experience includes (1) control and reduction of materials potentially toxic to fish, (2) habitat quantification, and (3) stabilization of stream banks and habitat in areas where repositories or industrial/commercial structures also must be protected. Our expertise includes:

- Floodplain restoration and revegetation to promote natural hydrologic conditions;
- Riparian zone revegetation and enhancement to improve fish habitat and production;
- Stream-bank stabilization and enhancement to reduce lateral erosion and improve fish habitat;
- Installation of in-stream structures to improve fish habitat such as, weirs for pool formation, boulders for mid-stream habitat, and large woody debris for instream and overhead cover;
- Hydrologic assessments of sediment movement and fluvial habitats; and
- Stream and lake liming to neutralize acidity and help protect against effects of potentially toxic metals.

MFG has developed action plans for implementing restoration projects. Sites where MFG action plans are being used include:

- Coeur d'Alene River, Idaho; and
- Kerber Creek, Colorado.

MFG staff have evaluated biological, physical, and chemical qualities of streams, lakes, and reservoirs. We have developed management plans based on acceptable alternatives to attain designated uses. Example projects include:

- South Platte River, Colorado;
- Animas River, Colorado;
- Adirondack Lakes, New York; and
- Twin Lakes, Big Horn Mountains, Wyoming.

MFG staff have authored and co-authored technical guidance documents related to stream, lake, and reservoir management and restoration. Examples include:

- "Salmonid-Habitat Relationships in the Western United States: A review and indexed bibliography" for the USDA Forest Service;
- "Fish and Fisheries Management in Lakes and Reservoirs" for the US Environmental Protection Agency; and
- "Practical Guide to Managing Acidic Surface Waters and Their Fisheries" for Living Lakes, Inc., Electric Power Research Institute, and the USDI Fish and Wildlife Service.



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## **MINE HYDROLOGY AND GEOCHEMISTRY**

*MFG offers specific expertise in mine hydrology, hydrogeochemistry and process engineering to provide environmental and engineering services to the mining industry.*

MFG has long served the mining industry by working to permit new mines and expand existing mines, designing dewatering systems for surface mining, assessing environmental impacts from mine drainage and mill tailings, designing treatment facilities for contaminated drainage, and planning and designing mine closures. MFG staff have conducted and managed projects for lead, silver, zinc, gold, copper, sand, gravel, and lignite mines; gravel quarries; smelters; mills; and associated operations on both small and large scale projects throughout the western United States.

Our staff have published research papers on mine hydrology and hydrogeochemistry in nationally recognized publications. We have given keynote presentations at mining-related conferences. MFG staff are affiliated with various national societies working to advance the knowledge about mine hydrology and hydrogeochemistry.

MFG's services in mine hydrology and hydrogeochemistry include:

- Baseline geologic and hydrologic studies;
- Evaluation and design of mine dewatering and depressurization systems;
- Geochemical analysis and simulation of the mobility of heavy metals, radionuclides, and other reactive constituents; and
- Treatability evaluations and treatment designs using conventional and emerging water treatment technologies, including bioreactors and constructed wetlands.

Example MFG projects include:

- Preparing permit application studies and groundwater control plans for 12 lignite mines in Texas;
- Performing a preliminary assessment of an open-pit mine, heap-leach facility in the Mojave Mining District of California, including compilation of historical information and site observations;
- Developing remedial designs for the Bunker Hill Superfund Site in the Coeur d'Alene Mining District of northern Idaho that included in-place closure of a 260-acre tailings and slag impoundment, treatment of metal-bearing waters from site sources using innovative, subsurface flow constructed wetland treatment systems, and design of a 9,000-foot floodway levee;
- Performing geohydrologic investigations of an underground hard rock mine consisting of a 6,500-foot-long haulage/drainage tunnel and 12 levels (1,200 vertical feet) of mine workings that included evaluation of potential impacts of a permanent mine adit plug on the mine and areal hydrology at the Bonanza Mining District in Colorado and extensive surface water hydrologic/hydraulic design studies throughout the 30 square mile mining district; and
- Performing surface water hydrologic studies and hydraulic design of remedial flood control facilities at various locations in a former mining district in Montana, the Upper Blackfoot Mining Complex (UBMC), as well as designing mine plugging and drainage collection facilities for various collection and treatment systems for the acid mine discharges.



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## ODOR ASSESSMENTS

*MFG has investigated odors for wastewater facilities, solid waste facilities, painting operations, food industry sources, chemical plants, and a variety of other sources.*

MFG has developed unique capabilities in the evaluation of odor impacts. Odor is a highly specialized and complex aspect of air quality assessment. Our capabilities are based on a solid technical understanding of the phenomena of odor and years of practical experience resolving odor problems.

A fundamental characteristic of the MFG approach to odor assessment is "keeping the human nose in the system." Our experience has taught us that attempts to resolve odor issues through chemical measurements alone are usually unsuccessful. Rather, a program of controlled human observations using trained odor scientists and technicians, and devices such as olfactometers and scentometers, has led to successful programs of odor quantification and problem resolution.

MFG's services in odor assessment include:

- Ambient odor measurement;
- Measurement of odor sources using olfactometry;
- Development and adaptation of computer models for evaluation of odor impacts;
- Preparation of odor discussions for NEPA and State Environmental Impact Statements;
- Compliance Order/Consent Order resolution;
- Resolution of conflicts and assistance with community relations for odor problems;

- Specialized odor studies and odor complaint response; and
- Expert witness testimony on odor subjects.

Specific project experience includes:

- Evaluated potential odor impacts for a solid waste disposal facility for the City of Mountain View, California, which were assessed using an odor model and computed expected concentrations of a series of airborne toxic chemicals potentially resulting from the landfill operation;
- Assessed potential odor implications for a proposed solid waste transfer station in Monroe, Washington, based on odor measurements at other transfer stations and the use of a proprietary MFG staff odor dispersion model;
- Assessed potential odor impacts from the active face and leachate lagoon areas of the proposed landfill for Snohomish County, Washington; also trained county personnel to measure odors and conduct community odor surveys;
- Evaluated potentials for gas emissions and off-site odor impacts related to a landfill in Klickitat County, Washington; and
- Measured and assessed odor intensities for various large hog facilities in Colorado, including odor characterization at property boundaries, receptors, and sources.



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## **STORMWATER MANAGEMENT**

*MFG provides expert assistance to clients addressing design and permitting needs for stormwater management.*

MFG staff have extensive experience in stormwater management for municipal, commercial, manufacturing, and mining facilities. Our services include:

- Analysis of runoff hydrograph events and design of channel floodways;
- Analysis of water surface profiles in channels and rivers for flood events;
- Design of diversion channels and detention ponds for contaminated and uncontaminated drainage;
- Design of water treatment basins;
- Design of pipelines and piping networks;
- Evaluation of watershed runoff and sediment loading;
- Design and stabilization of in-channel drop/sill and river barb structures to increase channel stability and promote aquatic habitat;
- Design of geomembrane-lined detention reservoirs;
- Flow control and discharge spillway design;
- Preparation of NPDES stormwater discharge permit applications; and

- Preparation of stormwater pollution prevention plans.

MFG's experience in the analysis and management of stormwaters includes:

- Construction of a 72-inch diameter storm sewer pipeline through an area contaminated with heavy metals. The project included the following issues: worker health and safety, excavation dewatering, tidal influence on groundwater, unfavorable weather conditions, treatment and disposal of contaminated water, and the storage, treatment and replacement of 30,000 cubic yards of excavated contaminated soil.
- Development of remedial management concepts for wood treatment chemicals in soil, stream sediments, groundwater, and surface water at a wood processing facility. This project included construction of stormwater runoff facilities.
- Design of various diversion ditches, channels, and associated structures for protection of closure facilities from flooding by 100-year/24-hour storm events. This project was performed as part of the remediation of the Bunker Hill Superfund site, the nation's second largest Superfund site by area.



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## ***SURFACE MANAGEMENT***

*MFG technical staff have considerable experience in management of surface natural resources. This work includes inventory and mapping of plant communities and landscape disturbances, assessment of land use impacts on native plant communities, and restoration and management of plant communities.*

We have provided our clients with practical, cost-effective management solutions for sustainable and productive land use. Our services include:

- Mapping (vegetation, erosion features, critical area delineation, basin delineation), using Global Positioning System (GPS) and Geographic Information Systems (GIS) technologies together with traditional inventorying and site assessments;
- Modeling and analysis of watershed sediment yield;
- Erosion control design, including "soft" measures such as upland and riparian vegetative restoration, bio-engineering, and "hard" measures such as grade control structures, bank protection, drainage and retention;
- Identifying and assessing landscape disturbances that may contribute to non-point source pollution in streams, rivers, and lakes;
- Evaluating upland watershed conditions through analysis of land uses in the upland watershed;
- Plant community inventories to evaluate native and invasive exotic plant species composition and distribution; Development of management strategies for invasive plant species control;
- Designing site-specific restoration and/or improvement of native plant communities and wildlife habitat including soil analyses, soil amendment strategies, developing seed mixtures and seeding specifications, and implementation oversight; and
- Developing Best Management Practices for erosion control and sustainable plant

communities, as well as disturbance minimization strategies.

The experience of MFG's staff in the analysis of surface conditions, design of surface condition restoration, and planning of Best Management Practices includes:

- Vegetation analysis and erosion modeling for a sedimentation analysis of the Rio Grande from Percha Dam in New Mexico to American Dam in Texas;
- Vegetation mapping, analysis of range conditions, and erosion feature mapping for a sedimentation analysis of a 30-square mile watershed study area, Fresno and San Benito Counties, California;
- Noxious weed survey and management planning for the Mid-America Four Corners Pipeline Project, Bloomfield, New Mexico to Seminole, Texas;
- Analysis and reclamation plans for lands disturbed by small scale mining in the Imataca Forest Reserve, Guyana Region, Venezuela;
- Post burn native restoration and right-of-way vegetation management planning for a 17-mile railroad right-of-way and adjacent residential community, Santa Fe, New Mexico;
- Native plant restoration seeding and erosion control for a 22-mile pipeline project, El Paso, Texas; and
- Native plant landscape design and dust control plan for a 30-acre liquid petroleum gas (LPG) transfer station, Ciudad Juarez, Mexico.



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## VADOSE ZONE ASSESSMENTS

*MFG provides experienced service investigating, assessing, modeling and characterizing contaminants in the vadose zone.*

MFG has considerable field and technical expertise in soil and water investigations and chemical transport in the vadose zone (i.e., the unsaturated soil and subsoil layers overlying the deeper subsurface layers saturated with groundwater). MFG's senior and support staff include scientists and engineers with broad experience in hydrogeochemical characterization of the vadose zone. We have developed a diversity of monitoring programs for land disposal facilities and prepared computer simulation models to support the design of groundwater and vadose zone monitoring networks.

MFG staff has provided vadose zone services to various industrial and government clients. Among these are RCRA treatment, storage and disposal facilities, potentially responsible parties for Superfund sites; a former semiconductor fabrication facility; and a National Park. Our staff has published professional research papers presenting hydrogeology and hydrogeochemistry results from modeling and vadose zone characterization work in nationally recognized publications. Many staff members are involved with national societies addressing advancement of knowledge regarding vadose zone characterization.

MFG capabilities and experience in vadose zone characterization includes:

- Calibration and operation of neutron soil-moisture meters;
- Collection and analysis of soil gas samples;
- Collection of pressure (vacuum) data from tensiometers using mercury manometers and portable vacuum meters;
- Collection of undisturbed soil samples and oriented cores;
- Collection of vadose zone fluids from suction lysimeters;
- Computer simulation of unsaturated flow and chemical transport;
- Design and installation of vadose zone monitoring wells;
- Design, operation and maintenance of single and multi-layer soil vapor extraction systems;
- Permitting and specification of soil vapor treatment systems;
- Evaluation of laboratory-determined soil moisture characteristic curves;
- Evaluation of perched groundwater zones;
- Installation of tensiometers, neutron probe access tubes, and suction lysimeters under various soil conditions; and
- Preparation of unsaturated hydraulic conductivity estimates.





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## WATER RESOURCES MONITORING

*MFG has extensive experience monitoring groundwater and surface water quality and flow.*

MFG's monitoring experience frequently emphasizes integrating comprehensive programs to address groundwater and surface water interactions. We have designed, installed, and implemented monitoring programs that have included periodic testing of disposed materials, documenting flow and quality of water and wastewater, and observing the performance of containment and treatment units. Our staff reviews proposed legislation and regulations on a continuing basis to anticipate future requirements.

MFG has conducted surface water and groundwater monitoring for a variety of engineering projects involving hazardous waste contamination, groundwater resources management, and environmental impact assessment. Examples of information collected include:

- Intrinsic bioremediation parameters;
- Concentrations of dissolved organic and inorganic chemicals in groundwater and surface water systems;
- Extent and distribution of non-aqueous phase liquids (NAPLs) that have been released into soil and groundwater;
- Lateral and vertical hydraulic gradients in an aquifer system;
- Fluctuations in water levels;
- Baseline groundwater and surface water quality of a site prior to industrial development;
- Performance of remedial action systems involving groundwater control for containment/cleanup of a contaminated site; and
- Performance of water supply wells, dewatering systems and groundwater barriers.

In addition to data collection, MFG has developed sophisticated database programs to process, store and manage monitoring data, perform statistical calculations, and produce tables and graphics for presentation.

Examples of monitoring projects conducted by MFG staff include:

- Managing the comprehensive water monitoring programs at the IBM Almaden Research Center in San Jose, California. The project included evaluation of groundwater and surface water quality at sampling locations throughout the approximately 600-acre facility.
- Designing and implementing a long-term groundwater monitoring system at a state Superfund site in East Palo Alto, California that contained high levels of arsenic in soil and groundwater.
- Preparing a Comprehensive Site Monitoring Program for the Albany (California) landfill, to assist the City of Albany in complying with California Regional Water Quality Control Board site closure requirements.
- Contributing monitoring guidance to a pair of EPA manuals for (1) completing total maximum daily load (TMDL) assessments during wet weather flows, and (2) characterizing and simulating combined sewer systems.
- Performing watershed-scale monitoring to evaluate surface water and groundwater metals loading sources and attenuation at mining districts in Colorado and Idaho.



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## **WATER RESOURCES PLANNING AND DEVELOPMENT**

*MFG provides a diversity of services designed to aid municipalities, industries, and agriculture in obtaining needed water supplies for continued development and growth.*

MFG has worked with municipal, industrial and agricultural users to meet water supply requirements. As part of these efforts, we have conducted water rights and environmental impact studies for stream diversions, interbasin water transfers, and large scale groundwater development. Our services and abilities in water resources development include:

- Groundwater supply exploration and development;
- Hydrologic and water quality impact assessments;
- Water quality, stable isotope and tracer studies to identify the source and pathways of water migration;
- Basin analysis of regional groundwater flow systems;
- See page control and drainage investigations;
- Evaluation of groundwater and surface water relationships;
- Water resources planning;
- Reservoir operations studies;
- Hydrogeologic and geochemical analysis in support of water rights applications;
- Well design and simulation of municipal well field operations; and
- Regulatory assistance and expert testimony.

Examples of specific water development projects conducted by MFG staff include:

- Worked with the Recreation and Park Department, City and County of San

Francisco, to rehabilitate the irrigation water supply system for Golden Gate Park. This included mapping the park's groundwater resources, drilling two test wells, preparing plans and specifications for two production wells, selecting the well pumps, designing mechanical and electrical systems, and installing two irrigation wells within the park.

- Evaluated quantity and quality of groundwater available to the City of Denver City to augment existing production from Ogallala Aquifer. Work included pumping tests, water quality analyses and review, and groundwater flow modeling. Results were used to assist Denver City in planning for future water needs.
- Investigated potential availability of groundwater to augment surface water supplies for a client in San Angelo, Texas.
- Assessed water quality effects associated with a proposed 134,000 acre-feet surface water diversion from the Platte River near Chapman, Nebraska into the Big Blue basin (the Landmark Project).
- Investigated the quantity and quality of groundwater available from an area adjacent to a large reservoir in Coke and Runnels Counties, Texas to evaluate the groundwater resources potential for developing a large residential community and golf course.
- Assessed consequences of flow trading between the City of Colorado Springs, Colorado wastewater treatment plant effluents and irrigation return flows to Fountain Creek and the Arkansas River to determine potential impacts of the exchanges on water quality and downstream users.





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## CONSTRUCTED WETLANDS AND BIOREACTORS

*MFG has designed and constructed wetlands and bioreactors that successfully treat acidity and heavy metals in mines and mined land drainages, municipal wastewater discharges, and landfill leachates.*

MFG has extensive experience in the design, construction, and operation of constructed wetland and bioreactor systems used to treat contaminated surface water and groundwater. Much of our experience has focused on addressing the use of constructed wetlands and bioreactors for the cost-effective treatment of acidity and heavy metals in drainage from mines and mined lands. We have experience with both free-water surface and subsurface flow treatment wetlands for both mine drainages and municipal wastewater discharges.

MFG provided technical design and quality control services for the City of Albuquerque's Constructed Wetland Pilot Project in New Mexico. This study gathered performance data and operational information to help the City evaluate whether to construct a full-scale, 500-acre treatment wetland to address comprehensive wastewater treatment and polishing needs for the City. A key issue of concern was the ability of the wetland to remove arsenic, silver, aluminum, particulate nitrogen compounds and bacterial loads and to meet highly restrictive NPDES discharge limits. The project also investigated the consequences of wetland treatment on water loss through evapotranspiration, and the potential benefits of the wetland as wildlife habitat.

MFG's experience in the design and construction of wetland treatment systems includes:

- Developed final design and specifications for three subsurface-flow anaerobic wetland treatment cells and two surface-flow aerobic polishing cells at a pilot demonstration site in Butte, Montana, designed to handle a flow rate of 36,000 gallons per day (GPD). The pilot cells were used by the University of Montana to provide hydraulic, thermal, biological, and chemical treatability information for a potential large-scale wetlands system in the Butte area for removal of metals from contaminated groundwater.
- Performed final design services and technical support for the construction of three (40 x 70 feet) subsurface flow wetland cells at the Bunker Hill Superfund Site in northern Idaho. The pilot system was constructed to provide hydraulic and chemical treatment information for use in design refinements for a 110-acre wetland to be constructed for removal of metals from site drainage. Different types and quantities of fertilizer and peat moss were incorporated within the gravel substrates along with various types of local wetland species. MFG developed a testing program that included the estimation of hydraulic conductivity, tracer tests, and chemical tests to assess nutrient releases.
- Final design of two wetland and bioreactor treatment systems in the Upper Blackfoot Mining Complex (UBMC) of Montana. The Mike Horse treatment system (100,000 GPD) included the design of a four-cell constructed wetland treatment system to remove heavy metals. The Paymaster adit treatment system (2,900 GPD) included a primary wetland treatment cell and a secondary cell to dissipate treated flows to the subsurface.
- Preliminary design of a 74-acre wetland treatment system to remove/retain dissolved metals from mine drainage (up to 4.2 MGD) and a 34-acre wetland treatment system to capture and treat groundwater at the Bunker Hill Superfund Site in Northern Idaho.
- Performing final design of a bioreactor pilot treatment system for mine drainages in Northern Idaho utilizing two types of bioreactor units with pretreatment. The pilot system is designed for 30,000 GPD. Data collected from these pilot units will be used to design full-scale treatment systems of up to 850,000 GPD.



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## **CONSTRUCTION MANAGEMENT**

*MFG manages and implements field construction projects to meet specific client needs, and to assure that these projects are completed and appropriately documented to professional standards.*

MFG offers a full range of construction management services to effectively plan, administer and control the implementation of projects meeting our clients' needs. Our services include:

- Constructability review of designs and remedial plans;
- Bid package preparation and bid evaluation;
- Cost estimating;
- Project scheduling;
- Cost control;
- Long-lead procurement;
- Field management;
- Start-up services; and
- Operations and maintenance training.

By integrating these activities with our expertise in regulatory assistance, site assessment, remedial design and environmental monitoring, we ensure successful project development and completion. We strive to keep strategic project issues in mind through all phases of a project from conceptual planning through engineering, design, permitting, construction, operation and compliance monitoring.

MFG's staff has developed expertise in field management built on experience from many general construction and environmental remediation projects, including:

- Coordinating and observing the performance of contractors and subcontractors;
- Developing and implementing quality control programs to assure compliance with technical specifications and plans;
- Effective documentation of all activities;
- Effective communication with all involved parties;
- Agency coordination;
- Progress reporting;
- Contract administration, including pay application review and approval, change order negotiations and dispute resolution;
- Monitoring and maintenance of project cost control and schedule;
- Safety program monitoring;
- Community relations;
- Preparation and maintenance of "as-built" drawings; and
- Preparation of closure certification reports.



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## GROUNDWATER REMEDIATION

*MFG tailors groundwater remediation efforts to address client and site-specific needs based on our experience, technical expertise and knowledge of federal, state and local regulations.*

MFG provides comprehensive professional services for remediation of contaminated groundwater. Our staff of remediation engineers, hydrogeologists, and other technical specialists has successfully implemented numerous programs for controlling migration of and remediating contaminated groundwater at sites throughout the United States. MFG's staff are experienced in the application of both *in situ* and *ex situ* remediation technologies. We are proficient in evaluating the technical and economic feasibility of remedial alternatives, designing and operating groundwater and free product recovery systems, conducting treatability studies and pilot-scale tests, evaluating the effects of natural attenuation, including intrinsic bioremediation, designing and operating *in situ* and *ex situ* treatment systems, construction management and regulatory agency liaison.

MFG groundwater remediation expertise includes:

- A 50-gpm groundwater extraction and treatment system, consisting of UV/oxidation and activated adsorption systems, used to hydraulically contain groundwater containing jet fuel, trichloroethylene (TCE) and other volatile organic compounds at a former manufacturing facility in San Jose, California;
- Granular activated carbon adsorption systems with capacities ranging from less than 10 gpm to more than 3,000 gpm to remove TCE, petroleum hydrocarbons and semivolatile organic compounds from extracted groundwater at industrial sites in California, Texas and New York;
- *In situ* air sparging and soil vapor extraction systems for groundwater containing volatile organic compounds and petroleum hydrocarbons at leaking underground storage tank sites and bulk fuel terminals in California, Colorado, Texas, Massachusetts and Arizona;
- Placing oxygen release compound (ORC®) in existing monitoring wells, in soil borings and in excavation backfill to enhance *in situ* biodegradation of dissolved petroleum hydrocarbons in groundwater;
- Demonstrating to the Colorado Department of Labor and Employment, Oil Inspection Section, the effectiveness of intrinsic biodegradation of petroleum hydrocarbons in groundwater as an appropriate remediation technology at a former car rental facility at Stapleton International Airport, Denver, Colorado;
- Design and installation of a 400-foot long french drain system to divert upgradient groundwater around a capped RCRA landfill in north Texas, reducing leachate pumping/disposal costs by more than 90 percent; and
- Design and construction of a bioventing and enhanced *in situ* bioremediation system consisting of air sparging and soil vapor extraction components at a site in Arizona where implementation of this state-of-the-art remedy required extensive negotiation with the regulatory agency.



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## **RECLAMATION OF DISTURBED LANDS**

*MFG has experience developing designs, plans, and specifications for reclamation of disturbed lands. Assessment of pre- and post-reclamation conditions is performed to ensure the relevance and success of reclamation plans.*

MFG staff have developed and implemented vegetation establishment schemes for large areas of disturbed lands. Many of these disturbances resulted from years of mining activities. MFG provides conceptual planning, soil testing, vegetation test plot establishment and monitoring, and development of specifications for implementation of vegetation establishment plans. MFG staff have conducted and/or overseen the major aspects of field implementation of these plans.

Reclamation activities typically are integrated with overall site remediation planning and implementation and often include surface recontouring and/or installation of structures for drainage control to hydrologically isolate waste materials. Site-specific reclamation designs are intended to address the disturbed areas as ecological systems which will become self-sustaining natural systems. Designs are geared to attain such a system as quickly as possible. Examples of our specific assignments related to reclamation of disturbed lands include:

- Revegetation plan development, permitting and implementation for remediated and disturbed areas;
- Development of plans and specifications for on-site reclamation activities;

- Sampling of vegetation and soils for field and/or laboratory analysis;
- Vegetation test plot development and monitoring;
- Design of seed mixtures which includes addressing local climate, plant adaptability to site conditions, potential native vegetation, and diversity of species;
- Vegetation cover measurement and mapping;
- Soil pH measurement and development of recommendations for adjustment, if required;
- Assessment of soil quality for growing conditions;
- Development of recommendations for suitable soil amendments to improve soil texture, water-holding capacity, organic matter content, nutrient content, erosion control, infiltration characteristics, and exchangeable sodium percentage; and
- Modeling and evaluation of pre- and post-reclamation scenarios to address long-term influences on runoff, erosion, and infiltration.



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## REMEDATION MANAGEMENT

*MFG practices a pro-active management approach during the implementation of remediation projects.*

MFG's staff have developed remedial action programs that include metal and organic waste remediation systems for soil, groundwater and surface water; biological treatment processes for organic and inorganic compounds; landfill leachate collections; and hydraulic control systems.

MFG has a remedial design staff proficient at providing cost-effective engineering solutions to satisfy specific client and regulatory requirements. Our staff includes civil, environmental, chemical, agricultural, and geological engineers who can efficiently interact with large PRP groups or individual site owners to address their needs.

Based on results produced by site assessment studies, MFG staff evaluate available information to develop a technically applicable and cost-effective management program. Aspects of a defensible management program include the development of evaluation criteria for each implementation strategy considered; evaluation of feasible remedial action alternatives including, as applicable, cost-benefit analyses, pilot-scale treatability tests; and preparation of plans and specifications, construction management, operation and maintenance, and monitoring.

During construction of a remediation system, we closely monitor and evaluate progress and performance to identify potential problem areas, allowing project management to address these issues before significant difficulties arise. This is especially important where the remediation is being conducted as part of a general construction project or concurrent with ongoing site operations. By minimizing the impacts of the remediation on the overall construction schedule, or ongoing site operations, MFG reduces the risk of incurring additional construction/remediation costs.

Our remediation management services include:

- Remedial investigations/feasibility studies;
- Design and implementation of treatability studies and pilot tests;
- *In situ* soil remediation;
- *In situ* and *ex situ* groundwater treatment;
- Soil excavation and *ex situ* treatment;
- Hydraulic control systems;
- Waste management;
- Underground and aboveground storage tank removal and closure;
- *In situ* bioventing, soil vapor extraction, and air sparging system design, construction and operation;
- Constructed treatment wetlands design and implementation;
- Landfill leachate collection systems;
- Construction management;
- Contract management;
- Construction dewatering and treatment systems;
- Industrial and municipal wastewater treatment systems;
- General civil, mechanical, and utility services;
- Economic feasibility evaluation;
- Evaluation and monitoring of natural attenuation, including intrinsic bioremediation; and
- Regulatory liaison.





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## SOIL REMEDIATION

*MFG provides in situ and ex situ soil remediation solutions for organic and inorganic soil contaminants.*

MFG has designed and implemented a broad range of remedies for contaminated soil. MFG staff are experienced in technical/economic evaluation of remedial alternatives, treatability and pilot-scale testing, full-scale remediation system design, construction oversight, system operation and maintenance, system permitting, and regulatory agency liaison.

MFG's experience in soil remediation projects includes:

- Soil vapor extraction (SVE) and bioventing systems to remediate hydrocarbon contaminated soils at leaking petroleum storage tank sites and bulk fuel terminals in Colorado, California, Arizona, and Texas;
- Remedial technology evaluation and treatability studies for soil and sediment contaminated with mercury, fluoride, cyanide, polynuclear aromatic hydrocarbons (PAHs), and chlorinated organic compounds at a 3,000-acre Superfund site in south Texas;
- Treatment of more than 11,000 cubic yards of soil contaminated with aviation gasoline and diesel fuel in an *ex situ*, static pile, solid-phase bioremediation system at a site in south Texas;
- Negotiation of soil cleanup levels based on human and ecological risk and fate and transport analysis;
- In-place closure/capping of a 260-acre mine tailings, gypsum and slag impoundment, a 35-acre former lead smelting facility, and a 25-acre zinc refining facility; and residential soils removals as part of the remediation of a large Superfund site in Kellogg, Idaho;
- In-place capping of soils at a 5-acre abandoned lead battery recycling site contaminated with lead, arsenic and antimony in Dallas/Ft. Worth, Texas;
- Fixation/ stabilization/ solidification of approximately 6,500 cubic yards of lead- and acid-contaminated soil at a former lead battery recycling site in Torrington, Wyoming;
- Long-term neutralization of approximately 14,000 cy of acid producing mine waste rock using lime kiln dust, and neutralization-stabilization of approximately 16,000 cy of mill tailings using quicklime at a former mining district in Montana;
- Excavation, treatment and disposal of nearly 22,000 tons of lead contaminated soils and soils mixed with asbestos at an operating recycling facility that is a Superfund site in Pocatello, Idaho;
- Design, installation, and operation of a fourteen well biosparging system for a manufacturing facility in St. Louis, Missouri to remediate soils impacted with food-grade oils and to mitigate oil migration to the Mississippi River; and
- Remediation of a closed shooting range, including excavation, stabilization and off-site disposal of approximately 7,000 tons of backstop soils contaminated with lead from pistol and rifle shooting and excavation, and off-site disposal of approximately 14,000 tons of soil contaminated with lead from trap and skeet shooting.



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## WASTEWATER TREATMENT AND MANAGEMENT

*MFG offers a full range of engineering services addressing industrial and domestic wastewater management needs.*

MFG has developed environmental engineering solutions for domestic and industrial wastewater management problems. We address client needs through hydraulic and process engineering analysis, treatability and pilot-scale testing, full-scale facility planning and design, construction management, preparation of manuals for facility operations and maintenance, water quality review, discharge permitting, air and odor monitoring, emissions control, and modeling.

MFG staff have evaluated and engineered wastewater collection and treatment projects ranging from a few thousand gallons per day to several million gallons per day (mgd). We have engineered systems for semi-conductor manufacturing facilities, aerospace industries, petrochemical plants, oil refineries, secondary lead smelting operations and the mining industry. Our work also has addressed treatment needs for processing high-strength landfill leachate, contaminated groundwater, and domestic wastewater.

MFG staff have worked with collection systems ranging from several hundred feet of small diameter collector sewers to systems of more than 70 miles of sewers as large as 72 inches in diameter. We have designed pumping stations and force mains with capacities up to 63 mgd and designed treatment facilities with capacities from a few thousand gallons per day to 35 mgd for municipal and industrial wastewaters. We also have conducted surface water and groundwater quality studies and have prepared permit applications for various effluent discharges. To ensure compliance with the Clean Air Act Amendments, we have conducted air quality monitoring and designed emissions control systems. We also have completed facility-wide odor evaluations, characterization, and modeling efforts to assess on-site odor levels and potential impacts from existing and proposed sources. To

mitigate facilities with unacceptable odor generation potential, we have designed odor control systems.

MFG's experience addressing wastewater treatment needs includes:

- Synthetic organic removal/recovery facilities involving aeration (packed tower, diffused aeration, surface aeration), adsorption (activated carbon, synthetic adsorbents), and chemical oxidation to treat contaminants such as phenols, chlorinated organics and petroleum hydrocarbons;
- Fixed-film, suspended growth and lagoon-based biological treatment facilities to remove BOD, nitrogen and biodegradable organic compounds;
- Treatment systems utilizing ion exchange, precipitation, sedimentation, filtration, oxidation and other technologies to remove iron, manganese, sulfur, and heavy metals;
- Pretreatment systems to remove oil, grease, and suspended solids from aqueous wastewater streams using oil-water separation and filtration technologies;
- Engineering services for wastewater collection systems ranging from design of new pumping stations and collection sewers to field evaluations of existing collection systems through dye testing, smoke testing and flow monitoring; and
- NPDES permitting for industrial stormwater and process water outfalls and industrial waste permitting for discharges to POTWs.

*Clients, References  
& Experience*



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## ***REPRESENTATIVE CLIENTS***

*MFG has numerous private and public sector clients. The following representative clients have depended on MFG for key environmental science and engineering solutions.*

- Aluminum Company of America (ALCOA)
- ARCO
- ASARCO Incorporated
- Avis Rent A Car System, Inc.
- Budget Rent a Car Corporation
- Burlington Northern Railroad
- Citgo Petroleum Corporation
- City of Albuquerque
- City of San Francisco, Recreation and Park Department
- City of San Rafael (California)
- Electric Power Research Institute
- Fleet Bank
- General Electric Company
- Gulf Coast Waste Disposal Authority
- Gulf USA Corporation
- Hecla Mining Company
- The Hertz Corporation
- Highway 36 Land Development Company
- Honeywell, Inc.
- International Business Machines Corporation (IBM)
- Laidlaw Environmental Services, Inc.
- Landels Ripley & Diamond, LLP
- Lead Industries Association
- Lower Colorado River Authority
- Montana Power Company
- Montana Resources
- NL Industries, Inc.
- National Car Rental System, Inc.
- Pacific Steel and Recycling
- Pillsbury Madison & Sutro LLP
- Roseburg Forest Products Co.
- J.R. Simplot Company
- Shell Western Exploration and Production, Inc.
- Stauffer Management/ICI Americas Inc.
- TXU
- Union Carbide
- Union Pacific Railroad
- Upper Big Blue Natural Resources District, Nebraska
- USPCI, Inc.
- Waste Management, Inc.
- Western Investment Real Estate Trust (WIRET)
- Zep Manufacturing Company



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## ***CORPORATE REFERENCES***

*The following individuals have offered to provide references regarding the scope and quality of environmental consulting and engineering services furnished by MFG. Please feel free to contact them.*

- Ms. Margaret Staub  
ASARCO Incorporated  
495 East 51st Avenue  
Denver, Colorado 80216  
(303) 296-5115
- Mr. Reed W. Neuman  
Howrey & Simon  
1299 Pennsylvania Ave., NW  
Washington, DC 20004  
(202) 383-6636
- Mr. Michael Thorp  
Heller, Ehrman, White & McAuliffe  
6100 Columbia Center, 701 Fifth Ave  
Seattle, Washington 98104-7098  
(206) 389-6200
- Mr. Bob Markworth  
Union Pacific Railroad Company  
1416 Dodge Street, Room 930  
Omaha, Nebraska 68179  
(402) 271-4054
- Mr. Matthew Fein  
Hecla Mining Company  
6500 Mineral Drive  
Coeur d'Alene, Idaho 83814-1931  
(208) 769-4100
- Ms. Betsy Temkin  
Temkin Wielga & Hardt  
1900 Wazee, Suite 303  
Denver, Colorado 80202  
(303) 292-4922
- Mr. Tom Root  
Root & Schindler  
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Denver, Colorado 80202  
(303) 572-1235



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## ***REPRESENTATIVE PROJECT EXPERIENCE***

*MFG has provided a multitude of environmental services for a variety of clients.*

MFG has provided comprehensive environmental consulting and engineering services to both private and public clients under CERCLA, RCRA and numerous state and local government regulations. The following is a brief overview of some of the hundreds of environmental projects MFG has performed:

- ***Bunker Hill Superfund Site*** - This site is the Nation's second largest Superfund site, by area. Located in the Coeur d'Alene Mining District of northern Idaho, MFG's staff has worked with this site since 1987 and directed its Remedial Investigation/Feasibility Study (RI/FS). Heavy metals (particularly cadmium, lead, and zinc) are widely distributed in the site media of air, water, and soil as a result of smelter operations, tailings dispersal and related activities. Almost 20-million cubic yards of mill tailings are present in two separate impoundments within the site, and an additional 10 to 12 million cubic yards of tailings mixed with alluvium mantle the valley floor. The remedial strategy devised addresses current human health and ecological risks using approaches and criteria that are acceptable to the client, regulatory agencies, and the public. This strategy includes: (1) remediation of residential soils; (2) erosion control measures for the hillsides and tributary basins; (3) demolition and in-place capping of the smelter and other beneficiation/process facilities; (4) in-place capping of tailings impoundments; (5) reprocessing or cement-based stabilization/fixation for principal threat materials; (6) innovative, constructed wetland treatment for groundwater and surface water; (7) floodway construction for the South Fork Coeur d'Alene River to limit tailings scour by flooding and to improve aquatic habitat; and (8) a supporting institutional controls system. MFG staff also completed an emissions inventory for wind-blown materials, a dispersion model evaluation study, and the estimation of contaminant concentrations and deposition rates for a health risk assessment. Based on available site information, MFG produced a series of Remedial Design Reports to define the remedial actions required for the overall remedy of this site. MFG also provided final design services, a construction bid package, and technical support for construction of three pilot subsurface flow wetlands at the site. These cells provided hydraulic and chemical information used as design criteria to construct a 110-acre wetlands to remove metals from site drainages.
- ***Eastern Michaud Flats Superfund Site (J. R. Simplot Company)*** - MFG is conducting the Feasibility Study for two areas within the site, the Simplot Operable Unit and a portion of the Offsite Operable Unit. In addition, MFG is assisting with the finalization of the Remedial Investigation. The EPA is regulating this site under CERCLA, although the site is composed of two operating facilities and an adjacent offsite area. The Simplot Don Plant produces phosphoric acid from phosphate ore using a wet process; the FMC Corporation Elemental Phosphorus Plant produces elemental phosphorus. The major objectives of the study are to develop and analyze remedial alternatives for any impacts related to plant operations.

MFG is looking at both current and historical activities at the Don Plant facility to assess impacts at the site. The primary pathways of concern being evaluated in the RI are groundwater, air and soils. The constituents of concern for groundwater include heavy metals and arsenic, selenium, gross alpha and nitrate. For the air pathway, active emissions being considered include cadmium, hexavalent chromium, arsenic and polonium-210. Fluoride emissions from historical activities are also being evaluated. The soils and solids pathway is being evaluated for the Don Plant site and offsite area. The primary exposure pathway is external gamma radiation for lead-210 and radium-226. MFG is looking at a full range of alternatives to address these pathways.

- ***Butte/Silver Bow Creek Superfund Site*** - MFG completed the Stage I Data Compilation effort as part of the ongoing RI/FS investigations conducted for the Butte Priority Soils Operable Unit (BPSOU) PRP



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Group in Butte, Montana. This effort examined and screened the existing physical and chemical data regarding the air, soil, surface water and groundwater media. Data usability in the 75 documents reviewed was evaluated based on methods defined by the Clark Fork River Superfund Site Investigations Data Management/Data Validation Plan. Pertinent data were input to a project database MFG developed using dBase IV software to be compatible with the Clark Fork Data Management System operated by the Montana State Library. A Historical Data Summary Report prepared by MFG describes the documents reviewed, methods used to assign data usabilities, and tabular database output. It also identified data gaps in the existing data. The approach substantially streamlined the RI/FS and provided a substantial cost savings.

- ***Master Planning, Permitting, Remedial Design for the Upper Blackfoot Mining Complex (ASARCO Incorporated and ARCO, Lewis and Clark County, east of Lincoln, Montana)*** - MFG developed the Master Remedial Plan, performed permitting assistance and developed Remedial Designs for remediation of the Upper Blackfoot Mining Complex (UBMC). Remedial designs were prepared for the Carbonate Mine, Anaconda Mine, Mike Horse Mine, Edith Mine, and Paymaster Mine areas of the UBMC. Previous mining and milling activities, including mine waste and mill tailing dispersion, resulted in distribution of heavy metals in site soils and surface waters. Remedial designs are based on a proactive voluntary early remedial action approach utilizing accelerated feasibility study evaluation procedures to develop the most appropriate alternative for remediation at each mine site. The remedial design has advanced through the preliminary and final design phases, including preparation of bid documents in 1993 through 1997. MFG staff have worked with agency personnel to obtain the necessary permits and have also prepared the construction contract documents to implement the reclamation.

Major components of the remediation at the site are a geomembrane-lined pretreatment pond at the Mike Horse Adit portal and a phased constructed wetlands treatment system for both the Mike Horse adit and the Anaconda adit discharges. The pretreatment pond is designed with an in-line oxidation system (ILS) with associated hydraulic control structures and emergency spillway, and an adjacent sludge drying bed with discharge into a conveyance pipeline. The pipeline conveys pretreated mine drainage from the pond to the constructed wetland cells. The wetland cells are designed to combine discharges from the Mike Horse and the Anaconda adits into a four cell multi-treatment system. The initial cell includes a sedimentation basin, a compost subsurface-flow basin and a gravel subsurface-flow basin, in series. The second and third cells provide subsurface-flow treatment followed by a final baffled surface-flow system. The wetland utilizes vegetation and is designed for year-round operation. The entire system is designed with intermediary hydraulic control structures between cells, discharge structures, and a runoff control system for high-flow storm events and protection from the peak flows resulting from the 100-year storm event in the adjacent Upper Blackfoot River. An operation and maintenance plan for the treatment systems was also developed, and an overall O&M plan for the entire site is currently being developed.

Permit and design considerations and technologies utilized in the remedial design for the Carbonate Mine, Anaconda Mine, Mike Horse Mine, Edith Mine and Paymaster Mine areas include:

- Preparation of permit applications for stormwater permits, 310 stream channel alteration permits, Army Corps of Engineers, 404 permits, and an MPDES permit for the treatment system discharge;
- In-place regrading and preparation, including mine shaft stabilization and closure, of the Upper Carbonate Mine waste rock pile for use as a repository;



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- Consolidation of materials from two locations, through removal and transport of Lower Carbonate Mine waste rock and tailing for disposal at the Upper Carbonate Mine area;
- Removal of the Anaconda and Edith Mine wastes with consolidation in a repository at the Mike Horse Mine area;
- Slope stability evaluations for determination of static and seismic factors of safety for final repository configurations;
- Design of surface water runoff and drainage control structures and rerouted stream channels;
- Design of low-permeability layers for repositories and design of gradation for drainage layer relative to overlying growth medium, including evaluation of final repository cover hydrologic variables, (infiltration, evapotranspiration, runoff, soil-water storage) using the HELP model;
- Design of a sludge dewatering bed atop the Mike Horse repository with all associated piping, controls and a leak detection system;
- Revegetation design, including determination of appropriate seed mixture, soil amendments, soil preparation techniques, and application techniques for closures and repositories;
- Final regrading plan, including configuration of the repository cap to promote runoff in Upper Carbonate Mine and Mike Horse Mine areas, and to maintain an existing wetland in the Lower Carbonate Mine area;
- Design of an instream diversion structure and pipeline, placed downstream of the structure to decrease infiltration of the Upper Mike Horse Creek into the existing mine workings;
- Design of mine shaft and mine adit cover, seal, and plug for the Anaconda Mine shaft and adit;
- Design of a geomembrane lined pretreatment pond at the Mike Horse Adit portal with associated collection and flow control works, piping, in-line jet pump-static mixer aeration system, and discharge spillway;
- Design of a phased constructed wetlands treatment system for mine discharges from the Mike Horse and Anaconda adits, including conveyance pipeline, hydraulic controls, monitoring systems, and all runoff controls;
- Design of channel stabilization and aquatic-riparian habitat enhancements along the Upper Blackfoot River and Mike Horse Creek adjacent to the constructed facilities;
- Design of a consolidated repository at the Paymaster Mine area, a passive wetland treatment system for the Paymaster adit discharge, and Paymaster Creek rehabilitation; and
- Preparation of preliminary estimates and engineer's construction cost estimates for various components of the project including capital costs for repositories and treatment systems and operation and maintenance cost estimates.





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MFG has also provided periodic construction oversight and consultation with construction managers during remedial actions at the various areas and will provide consultation during wetland treatment system startup and operation.

MFG's planning, design and consultation efforts have contributed to ASARCO being awarded the Lewis and Clark County Conservation District's 1995 Environmental Award for outstanding remedial work done at the UBMC.

- ***South Central Colorado Mining District*** - MFG conducted a water quality review for confidential clients within this mining district using existing recent data and historical information. This site was proposed for listing on the National Priorities List (NPL) based upon the EPA's Hazardous Ranking System (HRS) score. MFG's review identified impacts to the area's water quality attributable to recent mining activities and to impacts likely related to historic mining and/or natural mineralization. This review:
  - Surveyed available surface and groundwater quality information to assess current and historical conditions at the site and in its surrounding drainage basin;
  - Developed a database to store the compiled data, which was screened prior to entry using defined criteria; and
  - Used these data to identify impacts producing current conditions at the site.

MFG also evaluated whether specific contaminant sources and observed releases, which had been identified in the HRS document and formed the exclusive basis of the HRS score, were accurate and whether they were attributable to our clients or to other sources and actions. MFG concluded that the waste sources and releases that drove the HRS score primarily were derived on sources and activities other than those of our clients.

- ***Bonanza Mining District Cleanup, Voluntary Action (Bonanza Mining District Group, Saguache County, Colorado)*** - MFG is currently representing the Bonanza Mining District Group in a cooperative effort with the USDA Forest Service and the Colorado Department of Public Health and Environment (CDPHE) to assess surface water and groundwater impacts of several inoperative mining and milling sites within the Bonanza Mining District, and to perform voluntary cleanup actions. Work on private lands is being executed in accordance with applicable State and Federal permits. Work on Forest Service lands is being done under CERCLA Time-Critical and/or Non-Time-Critical Removal Action processes. Emphasis on a proactive client/regulator relationship has created an overall cooperative working environment. Although a hazard ranking (HRS) procedure was initiated, the Group and State and Federal agencies are working through cooperative arrangements to achieve a cost-efficient proactive cleanup of source areas outside of the Superfund process.

Specific work has included:

- Evaluation of the relative metals loading and associated metals concentrations (including As, Cd, Cu, Fe, Mn, Pb, and Zn) from point and non-point sources in the drainage mainstem and tributaries based on both high- and low-flow conditions;



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- Evaluation of the potential impact of metals-rich surface water drainage on alluvial groundwaters;
- Evaluation of trends in water quality, starting above areas of concern (mining and milling sites) and progressing to a point below the tailings impoundments downstream from the populated area;
- Biological integrity evaluations and use-attainability analyses;
- Negotiation with the CDPHE Water Quality Division to develop reasonable stream standards and goals for the District and downstream areas;
- Guidance and agency liaison for proposed voluntary cleanup actions;
- Development of an overall site prioritization with respect to addressing impacts from the areas of concern;
- Research and development of an ownership report for the District;
- Development of conceptual management plans and schedules for source areas;
- Development of sampling and analysis plans for site characterization;
- Development of implementation work plans, engineering evaluations, and cost analyses for cleanup of source areas;
- Preparation of detailed budgets and cost estimates for closure of tailing impoundments, a tailing and mine waste repository, and a mine drainage tunnel;
- Participation in public hearing processes and public meetings;
- Procurement of applicable State and Federal permits and negotiation of Applicable or Relevant and Appropriate Requirements (ARARs);
- Development of monitoring and control plans for remedial measures;
- Development of remedial designs and contract documents;
- Surface geologic mapping of fractures and other structural features (in preparation for tunnel plugging operations);
- Assessment of potential effects of mine plugging;
- Design and construction oversight of high-head (>1,000 ft) mine plug and associated tunnel rehabilitation and rock grouting;
- Design and construction of a consolidated tailings repository (~ 200,000 cubic yards), including detailed analyses of closure and capping options;



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- Design and construction of a surge and oxidation/sedimentation pond for passive water treatment;
  - Design and construction of in-place tailing closures;
  - Stream and riparian zone restoration and enhancement;
  - Administration of bidding processes and negotiation of contract prices;
  - Construction oversight and management; and
  - Preparation of construction completion reports.
- ***Comprehensive Site Characterization and Feasibility Study Program for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site (Alcoa)*** - MFG is part of a Contractor Team performing the remedial investigation (RI), baseline risk assessment (BLRA), and feasibility study (FS) of the Alcoa (Point Comfort)/Lavaca Bay Superfund Site. The site consists of an operating bauxite refining facility; aluminum fluoride plant, carbon paste plant, and nearby affected portions of Lavaca Bay. The AOC has three principal objectives: (1) investigate areas potentially impacted by historic site operations and waste management practices; (2) determine if impacted media associated with the historic releases represent an unacceptable risk to human health and/or ecological receptors; and (3) develop and evaluate remedial alternatives for any areas that are determined to pose an unacceptable risk to human health or the environment.

MFG assisted in the preparation of the Preliminary Site Characterization Report (PSCR), which summarized the existing and available site environmental data. The PSCR provided a framework for the identification of data needs, the development of data quality objectives for the RI effort, and identification of possible remedial action options for consideration during the FS. MFG had primary responsibility for preparing the evaluation of the nature and extent of contamination based upon existing data at the site.

MFG is directly responsible for the development of investigative strategies for site groundwater. The technical approach for investigating groundwater at the site is pathway based, relying on the evaluation of source-to-receptor pathways as complete or incomplete. Completed pathways will be the focus of investigation/characterization during the RI. The technical approach for groundwater is perimeter-based, whereby the investigation, characterization and installation of a groundwater monitoring network will focus on the potential for contamination at the perimeter of the site. Planning documents prepared as a foundation for the RI Work Plan have recognized the challenges of performing a "focused" RI at an active, operating industrial facility underlain by fluvial-deltaic-bay geologic materials with multiple aquifers and contaminant types.

Interaction within a dynamic, multi-contractor project team provides the need for communication with and understanding of a wide variety of technical disciplines including human health and ecological risk assessors, project chemists, quality assurance personnel, attorneys and plant personnel.

- ***Santa Margarita River Watershed Studies (Water Management Division, Region 9, U.S. Environmental Protection Agency, San Francisco, California)*** - MFG staff members designed, managed, and conducted a series of assessments on issues affecting water resources in this large southern California watershed. This work included assessments of present and potential future conditions for river,



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wetland, estuary, and ground water resources in this watershed. It reviewed beneficial uses associated with both the water bodies and the watershed, problems that presently or potentially affect these uses, data gaps that limit practical abilities to assess present and possible future conditions, and priorities and approaches for monitoring that would most contribute to understanding the system. The project produced a Geographical Information System (GIS) containing over 100 map layers for this watershed. Other project products include over 1,500 pages of reports, numerous supporting digital and printed databases, and an annotated and indexed bibliography for nearly 200 watershed documents. The work also included compiled listings on the watershed's biodiversity and on the present potential water resource uses and stressors in the watershed. Stressors of interest included zoning classifications, permitted wastewater discharge locations, water rights and use permits, Section 404 wetland permits, Superfund sites, landfills, known locations of underground storage tanks, and others. A component of this effort included the first comprehensive CWA Section 404 ADID (ADvanced IDentification of wetlands) process completed using GIS and existing watershed data. The information compiled and presented through this project provided the foundation used by the stakeholders in this watershed for their subsequent watershed assessment, planning, and management efforts.





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## ***STAFF QUALIFICATIONS***

*The senior personnel of MFG are widely recognized experts in the development and application of site assessment, hydrogeological and geochemical methods and remediation technologies.*

The following summary illustrates the professional qualifications and expertise of selected MFG personnel. These individuals are capable, consistent in their performance, and are quick to integrate the wealth of their experience with new, project-specific data. The firm's staff possess excellent communications skills, which is an integral aspect of our success on many complicated projects where MFG has served as the client's liaison. Many of our staff have participated in community relations activities and public hearings.

All staff members have established themselves as conscientious practitioners in their environmental science or engineering specialty. Through active participation in professional seminars and academic coursework, our staff remain on the leading edge of an evolving body of knowledge within their respective disciplines. Many of the MFG staff have worked closely together for a number of years, thus forming effective problem-solving teams that are highly responsive to client needs.

## **EXPERTISE**

Superfund Remedial Investigation/Feasibility Studies; Remedial Design and Construction Management; and Environmental Compliance for Operating Industrial Facilities.

## **PROJECT EXPERIENCE**

### **SUPERFUND RI/FS, REMEDIAL DESIGN AND CONSTRUCTION MANAGEMENT**

- **ASARCO, Incorporated, Murray, Utah.** Project manager for preparation of a Feasibility Study, Remedial Design and Construction Management for remediation of a former lead smelter site located in Murray, Utah. The site included the former smelter property, which had been sold by Asarco in the 1950s and was industrial use at the time of remedial investigation, and the surrounding residential/commercial areas. MFG represented Asarco during a series of mediation meetings with EPA, Utah Department of Environmental Quality, Murray City and the site landowners to negotiate the overall site cleanup. The final remedy required soil removal in the residential area and relocation of approximately 90,000 cubic yards of residual smelter materials to a fully encapsulated on-site repository system. The repository system was constructed to form the base of a Utah Transit Authority Park-and-Ride parking lot and for a four-lane road through the site to be constructed by Murray City. This allowed for redevelopment of the hundred-acre site for commercial/retail use under EPA's Brownfield's program. Remediation of the residential areas was completed in the fall of 1998. The Park-and-Ride parking lot repository was completed in April 1999 and the facility began operation in October 1999. In addition, Murray City recently completed installation of pavement over the roadway repository, which is now in use. Final remedial activities are expected to be completed by early fall 2000.
- **J.R. Simplot Company, Pocatello, Idaho.** Primary author of Feasibility Study reports for two of the three Operable Units at the site and project manager for remedial design for the Simplot Operable Unit. The Eastern Michaud Flats Superfund Site contains two operating phosphate ore processing plants: the FMC Elemental Phosphorus Plant and the J.R. Simplot Liquid Phosphate Fertilizer Plant. The site was relatively complex from a Superfund perspective with issues relating to air, soils, facility byproducts and wastes, surface water and groundwater. The continued operations of the two facilities, and the fact that remedial actions would affect process operations, was an additional complicating factor. MFG prepared the Feasibility Study for the Simplot Operable Unit and were also primary authors for the Offsite Operable Unit, which focused on soils and ecological risks. The feasibility studies were required to be prepared as three interim deliverables and one final submittal. MFG proposed a streamlined approach, which addressed the concerns of EPA, the State of Idaho and the Shoshone-Bannock Tribes while accelerating the process to produce a final Feasibility Study Report more quickly and cost-effectively. MFG is currently providing Consent Decree negotiation support and has prepared remedial design documents for key components of the remedy.
- **ASARCO, Incorporated, Leadville, Colorado.** Primary author of a Feasibility Study report for a former lead smelter/mill site. The site includes the partially demolished Arkansas Valley smelter, which operated from 1879 to 1961 and the remnants of the Colorado Zinc-Lead Mill which operated in the 1920s and 1930s. The feasibility study evaluated a range of remedial alternatives for the site, including covering with soil to offsite disposal. The remedy

recommended by the study was relocation of a relatively small volume of residual flue dust (with relatively high arsenic levels) to an on-site repository system and consolidating surface smelter materials from the roughly 50 acre site to the central smelter area to be covered by a one foot soil cap over approximately 10 acres. The remedy will open up much of the site for unrestricted commercial and will allow non-intrusive commercial/industrial activities on top of the soil cover. EPA has prepared a Proposed Plan for the site consistent with the Feasibility Study.

- **Hi-Ute Investment Company and Buehner Salt Lake Properties, L.C., Murray, Utah.** Project manager for development of a focused feasibility study and construction oversight for remediation of two smelter smoke stacks. The stacks were constructed as part of the Murray Smelter, which ceased operations in 1949. Recent remediation of the former smelter facility area has opened up the site for redevelopment. As part of this development the current site owner has decided to demolish the two smelter smoke stacks (450 and 330 feet tall) to allow general site grading and redevelopment to occur. The stacks contain elevated levels of heavy metals and one stack has an asbestos-containing mastic on the outside wall. MFG was responsible for preparing a focused feasibility study to identify and evaluate viable options for remediation of the stacks during demolition. MFG subsequently prepared portions of the demolition work plan associated with air monitoring/offsite cleanup and debris management and is currently serving as Scene Commander for the demolition event.
- **ASARCO, Incorporated, Everett, Washington.** Designed and oversaw the implementation of a soil investigation at the Former Everett Smelter Site. The smelter ceased operations in 1912 and the area was developed for residential use in the 1930s. The soil sampling effort was designed to evaluate the location of former smelter structures beneath the current ground surface and characterize the lead and arsenic concentrations in the various types of residual smelter materials present. Also authored the report, which provided interpretation of the data and findings to support the identification of an appropriate remedy. In addition, prepared a sampling and analysis plan for the residential area surrounding the former smelter plant site. The sampling plan covered approximately 600 residential properties, and various commercial and public areas. Protocols for delineation of the site boundary were also provided.
- **ASARCO, Incorporated, Beckemeyer, Illinois.** Part of team preparing the remedial design documents for the Circle Smelting Site. Primary responsibility is for design of the residential remediation, which will include soil removal at approximately 370 properties with clean fill replacement. Excavated soil will be transported to the smelter property for consolidation in a repository.
- **Union Pacific Railroad Company, Murray, Utah.** Provided technical assistance in the development and negotiation of a voluntary cleanup of a former rail yard as part of construction of the Utah Transit Authority light-rail system in Salt Lake City. The former rail yard contained fill material from historical mining/smelting operations in the area. The remedy included relocating smelter material identified as a potential source of arsenic to groundwater to a lined berm and covering of other material high relatively high lead concentrations during construction of the UTA rail system.
- **Union Pacific Railroad Company, Salt Lake City, Utah.** Providing technical assistance and litigation support for investigation and cleanup of the Northwest Oil Drain Site.



- **Hecla Mining Company, Toole, Utah.** Provided technical review and cost allocation support for a former cobalt processing facility in Toole, Utah.
- **Murray City Corporation, Murray, Utah.** Prepared a Sampling and Analysis Plan to characterize levels of heavy metals in the masonry of two smoke stacks from a former lead smelter. The investigation was designed to support evaluation of viable options for stabilizing the stacks structurally without affecting their visual appearance.
- **ALCOA, Incorporated.** Primary author of the Fate and Transport section and the Nature and Extent of Contamination in Soils section of a Preliminary Site Characterization Report for a Superfund site in Texas.
- **Confidential Client. Georgia.** Investigation of wastewater treatment ponds and a landfill at an aluminum molding facility, under CERCLA regulations, including installation of groundwater monitoring wells and sediment and groundwater sampling.

#### **INDUSTRIAL ENVIRONMENTAL COMPLIANCE – WASTE WATER AND STORMWATER ISSUES**

- **Various Clients.** Evaluation and design of wastewater treatment systems for various industrial clients. Systems included a Continuous Countercurrent Ion Exchange (CCIX) system to remove metals from chemical manufacturing facility wastewater; a coprecipitation/filtration system to remove heavy metals from wastewater, a bacterial/chelating compound destruction pretreatment system for shower water at a lead-acid battery manufacturing facility; and small-scale drinking water systems to remove heavy metals, iron, manganese, and sulfur.
- **Florida Tile Industries, Inc., Lakeland, Florida.** Performed a comprehensive storm water pollution study at a tile manufacturer, including pollutant source and process evaluations, water collection and treatment system evaluation and redesign and evaluation of the impact on water and sediment quality in the adjacent lake due to zinc and lead in the plant discharge. Also prepared the annual Toxics Reduction Inventory Release Forms covering releases into surface water, soil and air from the facility.
- **GNB Incorporated, Various Locations.** Prepared numerous NPDES Industrial Storm Water, Process Water, and Pretreatment Discharge permit applications, modifications and compliance studies for industrial facilities in 16 states. Developed a computer software program to manage daily wastewater discharge flow and pollutant concentration data from 16 facilities. The data were used to evaluate wastewater treatment system performance, compliance with permit discharge limitations and effectiveness of the corporate waste reduction program.
- **Republic Engineered Steel, Massillon, Ohio.** Performed an investigation into the sources of thallium and aquatic toxicity in the wastewater discharge from a steel mill. Also, performed bench wastewater treatment testing using ion exchange resin to provide a conceptual design of the treatment system.
- **GNB Incorporated. Columbus, Georgia.** Prepared the design of a storm water collection and treatment system for a new lead smelting facility.

- **Exxon Baton Rouge Plastics Plant, Baton Rouge, Louisiana.** Managed a Toxicity Reduction Evaluation at the manufacturing facility. The project included monitoring wastewater effluent toxicity, evaluation of chemical usage, housekeeping and operating procedures, wastewater collection and treatment system characterization, Toxicity Identification Evaluations, and the design and implementation of methods to eliminate effluent toxicity. Effluent toxicity was controlled by modification to chemical usage in the facility's cooling system.
- **Westlake Petrochemicals, Inc, Lake Charles, Louisiana.** Managed a Toxicity Reduction Evaluation (TRE) at the ethylene/styrene manufacturing facility. The project included the typical TRE components (see above) and also included tidal modeling of the receiving stream to allow for higher discharge limits to be allowed by the State. Effluent toxicity was brought into compliance by a modification to discharge limits based on the tidal modeling and upgrades of process equipment to reduce chemical losses to wastewater.
- **BP Oil Refinery, Belle Chase, Louisiana.** Designed and implemented a hydraulic characterization investigation of the refinery wastewater collection and treatment system by dye testing. Concurrently measured wastewater flow rates at key points within the sewer system. The study allowed for identification of problems with the collection system due to infiltration of groundwater and with the pond treatment system due to short-circuiting. In addition, prepared a comprehensive Spill Prevention Pollution Plan for the refinery and prepared Toxic Release Inventory forms for releases to surface water, air and soil.
- **Freeport-McMoRan, Inc. New Orleans, Louisiana.** Project manager for implementation of a sampling study along 100 miles of the Mississippi River to determine the impact of runoff from gypsum piles on the water and sediment quality in the river and on drinking water taken from the river.
- **Exxon Chemical, New Orleans, Louisiana.** Participated in the establishment of a spill response team for a local oil refinery. Also acted as head of a team, which responded to a chemical spill from a transport barge in a local bayou. The field effort included monitoring the fish kill and water sampling to evaluate the fate and transport of spilled material.
- **Exxon Oil Refinery, Baton Rouge, Louisiana.** Designed and implemented an investigation into the environmental impact of oil refinery wastewater discharges by comprehensive water and sediment sampling using the Waste Load Allocation approach. The refinery had eight discharge points along the stream, which also received discharge from numerous points from an adjacent rubber manufacturing facility. The goal of the study was to obtain information of current loading to the stream (from surface water samples) and historical sources, including adjacent closed facilities (from sediment chemistry).
- **BASF, Geismar, Louisiana.** Calculation of a water flow balance for an eleven-facility, integrated chemical manufacturing site to support an NPDES permit application. Also prepared a Spill Prevention Control and Countermeasure Plan for the entire site covering all liquid chemicals handled, processed or stored.

**INDUSTRIAL ENVIRONMENTAL COMPLIANCE – SOLID AND HAZARDOUS WASTE ISSUES**

- **Alcoa, Inc., Point Comfort, Texas.** Assisted in a waste characterization study at an alumina production facility. Responsibilities included working with process engineers to identify waste streams and collection of samples for chemical analysis.
- **GNB Incorporated, Mississippi Facilities.** Development of waste minimization programs at a lead-acid battery manufacturing facility, a lead oxide production facility and a polypropylene battery case manufacturing facility in Mississippi. Projects included a complete investigation of each process to identify the generation points of all solid and hazardous wastes, evaluation and application of methods to reduce or eliminate each waste, and establishment of a company procedure to implement and monitor waste reduction.
- **GNB Incorporated, Columbus Georgia.** Assisted in the preparation of a RCRA permit application for a new secondary lead smelter in Georgia, and RCRA permit modifications for waste piles and slag disposal at an operating secondary lead smelter.
- **GNB Incorporated, Mendota Heights, Minnesota.** Conceptual design of an electrowinning unit to produce metallic lead from smelted lead-acid battery scrap. Assisted in the preliminary design of a secondary lead smelting facility.

**INDUSTRIAL ENVIRONMENTAL COMPLIANCE – AIR ISSUES**

- **Exxon Baton Rouge Plastic Plant, Baton Rouge, Louisiana.** Modeling and measurement of VOC emissions from the wastewater sewer system at a polyethylene production plant. Also, modeling and measurement of ethylene emissions diffusion from polyethylene pellets in product silos.

**PROFESSIONAL EMPLOYMENT HISTORY**

Senior Chemical Engineer - MFG, Inc.; Colorado (1994-Present)  
Project Chemical Engineer - Lake Engineering, Inc.; Georgia (1990-1993)  
Staff Chemical Engineer - C-K Associates, Inc.; Louisiana (1988-1990)  
Systems Engineer - British Aerospace, Plc.; Stevenage, England (1983-1987)

**EDUCATION**

M.S., Chemical Engineering - Louisiana State University (1989)  
B.S., Chemical Engineering - University of Exeter, England (1983)

***EXPERTISE***

Planning and Project Management for Large-Scale Multi-Disciplinary Projects, Feasibility Studies, Remedial Design and Natural Resource Damage.

***PROJECT EXPERIENCE***

- Member of a panel of five experts identified by mining companies and State and Federal natural resource Trustees to characterize the conditions of the upper Arkansas River drainage and to identify and evaluate actions to restore portions of the drainage that have been impacted by historic mining- and metals-refining activities in and around Leadville, Colorado.
- Coordinating technical expert for the defense of a large CERCLA Natural Resource Damage claim involving alleged heavy-metals impacts to a 6,000 square mile watershed in northwestern United States.
- Project Manager for technical efforts in support of a good faith offer and corresponding negotiations to resolve a CERCLA NRD claim against Union Pacific Railroad.
- Project coordinator for integration of Trustee NRD restoration planning with the Feasibility Study process for the Jasper County Superfund Site in Jasper County, Missouri.
- Project Manager for the Eastern Michaud Flats Superfund Site Feasibility Study (J.R. Simplot Company portion).
- Project Director for Bunker Hill Superfund Site Feasibility Study, Consent Decree Negotiations and Remedial Design program. The Bunker Hill site is a 21-square-mile site containing metals mining and refining facilities. Primary issues of concern are health impacts to residents, impacts to groundwater and surface water quality and ecological effects within the site and in the surrounding Coeur d'Alene River Basin.
- Project Manager for the Circle Smelting Corporation Site, in Beckemeyer, Illinois.
- Technical Consultant regarding the CERCLA remedy/NRDA restoration development process for multi-party mediation for the former Murray Smelter Site in Salt Lake City, Utah.
- Technical Consultant regarding the MTCA remedy development process for multi-party mediation for the former Everett Smelter Site in Everett, Washington.
- Technical Consultant to counsel for the development of comprehensive project strategies and subsequent negotiations with responsible agencies for several former metals refining sites currently on the NPL.
- Lead Technical Consultant for litigation addressing TCE contamination of groundwater in an urban/industrial setting in Denver.

- Technical Consultant for a land owner participating in the strategic development of a large parcel of property in lower downtown Denver. The development of the property was planned in a manner to accomplish site remediation. Both soils and groundwater within the property are contaminated by a range of organic compounds and heavy metals.
- Senior Consultant participating in remedy development for a variety of metals mining and refining sites including:
  - Sergeant Road Site: Dallas, Texas
  - Metals Recycling Site: Fort Worth, Texas
  - Upper Blackfoot Mining Complex: Lincoln, Montana
- Project Manager for a confidential PRP allocation study for a lead-smelting facility in western United States.
- Project Manager for the Butte Priority Soils Operable Unit Phase I Remedial Investigation of the Silver Bow Creek/Butte Area Superfund Site.
- Remedial investigation/feasibility study manager for the flue dust operable unit of the Anaconda Smelter Superfund sites. Responsible for conduct of the feasibility study and preparation of the RI/FS report.
- Remedial investigation manager for the Bunker Hill Superfund site in Kellogg, Idaho. Responsible for project organization, technical coordination, review of all reports and negotiations with the EPA for RI work.
- Principal investigator for RI/FS soils and air quality/fugitive dust investigations at the Bunker Hill Superfund site in Kellogg, Idaho.
- Site manager for a coal tar contamination RI/FS at a large coal gasification facility in Salt Lake City, Utah. Responsible for the investigation and remedy selection process for soil and groundwater contamination at the main facility as well as peripheral facilities.
- Principal field investigator for the Eagle Mine Site site-specific water and mine water programs in Minuturn, Colorado.
- Principal investigator for several studies addressing contamination of soils and groundwater at natural gas collection and processing facilities in Wyoming, Utah and Colorado.
- Preparation of various documents (work plans, quality assurance project plans, laboratory analytical protocol, estimates, etc.) for a variety of RI/FSs in the western United States.
- Designed, coordinated and executed mining wastes, soils, surface water and air quality sampling programs for RI/FSs in the western United States.
- Designed, constructed and operated a water treatment system (granular activated carbon adsorption system) for removal of organics from groundwater.

- Field supervisor of drilling, well installation and sampling for hazardous waste contamination investigations in Utah, Colorado, Idaho, New Mexico and Wyoming. A variety of conditions, health and safety programs, and analytical procedures were experienced. Coordination with analytical laboratories for analysis and submittal of data for major projects.
- Scientist, Department of Environmental Quality. Responsible for inspection/audit activities for a variety of industrial facilities with permitted and non-permitted emission sources.
- Acted as onsite representative and conducted soils, ground and surface water sampling for the Environmental Impact Statement (EIS) for the Durango smelter mountain tailings project under the Federal Uranium Mill Tailings Remedial Action Program (UMTRAP). Provided field installation of all environmental monitoring sites and conducted all radiological and air quality sampling for the client (Sandia National Laboratories).

### ***PROFESSIONAL EMPLOYMENT HISTORY***

President/Senior Consulting Environmental Engineer - MFG, Inc.; Colorado (1991-Present)  
Project Manager - Dames & Moore; Colorado (1984-1991)  
Scientist - State of Utah; Utah (1983-1984)  
Site Representative - Dames & Moore; Colorado (1981-1983)

### ***EDUCATION***

M.S., Environmental Engineering - Colorado School of Mines  
B.S., Molecular Biology/Genetics - University of Utah

### ***PROFESSIONAL AFFILIATIONS***

Association of Ground-Water Scientists and Engineers, NGWA

**EXPERTISE**

Civil Engineering; Hazardous Waste Facility and Mine Remediation; and Dam and Hydraulic Structures Design.

**CERTIFICATION**

Professional Engineer - Illinois, No. 062-053064 (1999)  
Professional Engineer - Utah, No. 340480 (1997)  
Professional Engineer - New Mexico, No. 12684 (1995)  
Professional Engineer - Montana, No. 11487PE (1994)  
Professional Engineer - Idaho, No. 6984 (1992)  
Professional Engineer - Wyoming, No. 6131 (1991)  
Professional Engineer - Colorado, No. 14707 (1977)

**PROJECT EXPERIENCE**

**MINE REMEDIATION AND HAZARDOUS AND INDUSTRIAL WASTE FACILITY REMEDIAL DESIGN**

- Engineer of Record for remedial design at a former lead smelter site, including an on-facility repository for arsenic-contaminated materials and smelter complex remedial design, including coordination of design with various site redevelopment activities, Utah.
- Engineer of Record for design of a tailings closure plans for facilities, process areas, residential area remedations, mine waste rock pile and mine adit plugging program at the Triumph Mine site in central Idaho.
- Engineer of Record for a remedial design project at the Upper Blackfoot Mining Complex including three mine waste repositories, mine infiltration control and mine adit discharge hybrid treatment systems with conventional pretreatment and constructed wetland polishing including all ancillary facilities, Montana.
- Engineer of Record for a remedial design project at the Bonanza Mining District including tailings consolidation and repository design, flood control and stream channel rehabilitation design with aquatic/riparian habitat enhancements and mine discharge control including adit plugging, runoff control and oxidation/sedimentation pond, including certification of constructed components, Colorado.
- Engineer of Record for design of a pilot demonstration project for alternative constructed wetland treatment systems at a CERCLA site including an initial surge pond, three types of subsurface-flow test cells and two types of surface-flow test cells with extensive monitoring systems, Montana; and for a hybrid pretreatment-wetland treatment system pilot project for mine drainage, northern Idaho.
- Engineer of Record for streambank and channel remediation along the South Fork Coeur d'Alene River including stabilized levee and in-channel stabilization and habitat enhancement

components, design of a large mine waste repository, and design of a system to divert and treat secondary effluent from a municipal wastewater treatment plant in a natural wetland, Idaho.

- Development of work plans and preliminary designs for the Bunker Hill CERCLA site FS and RD; Groundwater/Surface Water Collection and Diversion; Collected Water Wetlands including final design of a demonstration method treatment system; Smelter Complex closure; Floodway and Central Impoundment Area Closures, Idaho.
- Provided technical expertise on the inspection and certification of surface coatings and linings for tanks, storage and containment areas, and assessment of repairs at a hazardous waste treatment, storage and disposal (TSD) facility and review and certification of a subsurface investigation report for a secure landfill cell at the TSD facility, Colorado.
- Various senior planning and design review of civil and geotechnical remedial projects for mill tailings and industrial facility developments and closures.
- Hazardous and industrial waste landfills, impoundments and groundwater extraction systems for CERCLA and RCRA sites; Utah, Ohio, Wyoming, New York, Florida, Colorado, Idaho and Texas.
- Mine remediation design including civil site work, flood control channels, groundwater extraction systems, temporary treatment facilities, mine adit bulkhead and shaft cover designs; Colorado.
- Expedited engineering evaluation/cost analysis (EE/CA) for the Colorado Tailings operable unit of the Silver Bow Creek/Butte Area Superfund site in Montana.
- Wastewater treatment facilities and contaminated groundwater treatment plant final designs; Colorado, Arizona, Oklahoma and Guam.
- CERCLA site feasibility studies (FS) and focused feasibility studies (FFS) for sites in Colorado and Idaho.
- Bioremediation landfarm design for oily wastes and landfarm closure design at a RCRA facility in Wyoming.
- Solid waste and municipal landfill designs, including active methane gas venting system designs and specifications; Colorado, Arizona and Illinois.
- Nuclear waste disposal site isolation and encapsulation design study, and cost/benefit analysis; Idaho.

#### **WATER RESOURCES AND GENERAL CIVIL ENGINEERING**

- Roller compacted concrete (RCC) dam designs (80 to 260 feet high) for water supply, flood/pollution control and diversion dams including stability analyses, intake structures,



outlet works, spillways, reinforced concrete, access, reservoir and peripheral design; California and Arizona.

- Irrigation dam rehabilitation design, Colorado; water supply rockfill dam design, with concrete facing, Guam; and tailings dam and spillway designs; Missouri, Colorado and Alaska.
- Flood control diversion design, leachate basin, pumping, pipeline systems, decant systems, river stabilization, floodwall, mine railroad bridge design and construction inspection; Arizona, Colorado.
- Heap leach project designs; Colorado and Nevada.
- Offshore runway extension and airport expansion design and cost estimate for \$60 million job; Alaska.
- Wind Energy Project, site grading and drainage, access roads and control and maintenance buildings; California.
- Pipeline route selections and assessments for industrial water supply in Wyoming, Montana, North Dakota and South Dakota; and pipeline settlement analyses and remedial design at a powerplant constructed over collapsible soils, Utah.
- Hydroelectric feasibility study, Wyoming; and water supply reservoir yield analysis, spillway studies and preliminary design of dams, Alaska, New Mexico and Colorado.
- Design and contract documents for large irrigation, drainage, pumped storage, hydroelectric, and water supply projects of up to 21,000 cfs.
- Research in water quality - heavy metal removal and desalination techniques.
- Construction inspection - canals, pipelines, geothermal, and desalination test facilities, and construction cost estimating for various projects.
- Technical review of major earth dam failure.
- Planning, layout, design, construction and management of a number of water supply and bridge projects for rural communities.

### ***PROFESSIONAL EMPLOYMENT HISTORY***

Senior Engineer - MFG, Inc.; Colorado (1992-Present)  
Project and Senior Engineer, Dames & Moore (1978-1992)  
Civil Engineer - U.S. Bureau of Reclamation (1975-1978)  
Civil Engineer - U.S. Peace Corps Ecuador (1973-1975)

***EDUCATION***

B.S., Civil Engineering - Valparaiso University (1972)

***PROFESSIONAL AFFILIATIONS***

American Society of Civil Engineers

Engineering Ministries International (water resource design assistance for orphanages, hospitals and schools in developing countries)

***PROFESSIONAL DEVELOPMENT/CONTINUING EDUCATION***

Health and Safety Training, 40 hr. OSHA (1990 and subsequent refresher courses)

Wastewater Treatment with AIWPS and Constructed Wetlands, ASCE (1998)

Settlement and Consolidation Analyses, ASCE (1996)

NPDES Construction Stormwater Permit Compliance ASCE (1994)

Designing with Geosynthetics, Drexel Research Institute (1990)

Quality Assurance and Control for Design and Construction, ASCE (1988)

Cavitation in Hydraulic Structures, ASCE (1984)

Various Civil and Structural Short Courses, ASCE

***PUBLICATIONS***

"Wetlands Treat Mine Runoff," *Civil Engineering*, American Society of Civil Engineers, January, 1999, Co-author.

"Design and Optimization of the Mike Horse Mine, Montana, Wetland Treatment System," ASCE Wetlands Engineering & Rivit Restoration Conference, 1998, Co-author.

"A Case History of Tailings Consolidation and Closure at the Bonanza Mining District;" Tailings and Mine Waste '97, Colorado State University, 1997, Co-author.

"Design and Construction of Lower Chase Creek Dam," Roller Compacted Concrete II, ASCE, 1988, Co-author.

"Development of Design Criteria and Final Design of Hydraulic Structures for Pamo Dam;" Design of Hydraulic Structures, Colorado State University, 1987, Co-author.

***LANGUAGE PROFICIENCY***

Spanish

*COUNTRIES WORKED IN*

Australia  
Belize  
Bolivia  
Ecuador  
Guam  
Honduras  
Papua New Guinea  
Singapore  
United States

## **EXPERTISE**

Site Investigation and Remediation; Groundwater Hydraulics and Flow Systems Analysis; Aqueous Geochemistry; Hazardous Waste Management; Mining Hydrology; Expert Testimony; and Regulatory Assistance.

## **CERTIFICATION**

Certified Professional Geologist, No. 5105 - American Institute of Professional Geologists (1981)

## **REPRESENTATIVE PROJECT EXPERIENCE**

### **SITE INVESTIGATION AND REMEDIATION**

- **Hydrogeologic Study, IT Corporation, Contra Costa County, California** - Managed the comprehensive geologic and hydrogeologic investigation of a large hazardous waste treatment, storage and disposal facility located in marshlands bordering Suisun Bay northwest of San Francisco, California. The investigation included the use of sophisticated downhole geophysical and hydraulic testing methods, and geochemical evaluation of inorganic and organic species, to evaluate actual and potential contaminant migration pathways.
- **PCE Spill Investigation and Remediation, Ellehammer Packaging, Inc., Olympia, Washington** - Managed the investigation and remediation of soil and groundwater affected by a spill of tetrachloroethylene at a plastic packaging plant. Soil contamination was addressed by a combination of insitu treatment with hydrogen peroxide and limited soil excavation and offsite disposal. Groundwater monitoring is continuing to document the effects of source removal.
- **Investigation and Remedial Design for Urban Waste Site, Dallas, Texas** - Directed the remedial investigation of a large urban industrial site for a diverse PRP group. The site had been used as a repository for municipal and industrial wastes, including large volumes of secondary lead smelter slag and broken battery cases. The focused investigation, which included a preliminary exposure assessment and development of early remedial actions, was completed within a four-month time period. Careful slow purge techniques were utilized to demonstrate that previous groundwater chemical data for trace metals were biased by mobilization of solids during sampling. An expedited voluntary closure, including capping, surface drainage modifications and groundwater monitoring was designed and successfully implemented.
- **LUST Investigation and Remediation, Avis Rent A Car System, Inc., SeaTac, Washington** - Conducted an investigation at Seattle-Tacoma International Airport to: 1) identify sources of petroleum hydrocarbons in soil and groundwater; 2) delineate the extent of hydrocarbon constituents in these media; and 3) develop cleanup action levels and design remedial measures.
- **Superfund Feasibility Study and Remedial Design, J.R. Simplot Company, Pocatello, Idaho** - Serving as the Lead Technical Consultant for groundwater aspects of the Feasibility

Study and remedial design. Groundwater extraction and reuse is the selected remedy to control seepage from the gypsum stacks of this operating fertilizer production plant.

- **Hydrogeologic and Contaminant Investigations, Union Carbide, Seadrift, Texas** - Conducted and/or managed various hydrogeologic investigations for a large petrochemical complex on the Gulf Coast of Texas. Waste management units at the site included unlined ponds, hazardous waste landfills and spill areas. These investigations were directed primarily toward evaluating subsurface hydrogeologic conditions, relationships between groundwater flow systems and tidally-influenced surface water bodies, the extent of subsurface contamination, the design and evaluation of groundwater monitoring systems, and the technical performance of groundwater remediation efforts.
- **Crude Oil Pipeline Spill Evaluation, Anderson Ranch, Texas** - Evaluated the impacts to soil and groundwater associated with a crude oil pipeline spill in South Texas, assessed potential remedial measures and assisted in negotiations with the Railroad Commission of Texas over cleanup levels and remedial actions.

#### **EXPERT TESTIMONY AND LITIGATION SUPPORT**

- **Expert Testimony, Hecla Mining Company, Republic, Washington** - Provided expert testimony in defense of a Clean Water Act citizen suit filed against a gold and silver mine/mill complex in the Northwest U.S. The major issues involved the definition of point sources, tailings impoundment seepage estimates, and effects on groundwater and surface water quality.
- **Expert Testimony, Republic Waste Industries, Inc., Edinburg, Texas** - Providing litigation support and expert testimony in defense of a civil suit filed against a municipal waste landfill in South Texas. Specific areas of expertise include hydrogeology, contaminant fate and transport, contaminant source evaluation, and groundwater flow simulation.
- **Expert Testimony, Bee County, Texas** - Provided expert testimony regarding the impacts and remediation costs associated with a liquid hazardous waste spill in South Texas.
- **Expert Testimony, C.H. Wylie Trust, Coke and Runnels Counties, Texas** - Served as principal investigator and expert witness for the landowner in a civil suit regarding widespread contamination of surface and subsurface water as result of oil production activities on the 28,000 acre Chadbourne Ranch in West Texas. The investigation involved installation and monitoring of wells, gauging and sampling surface waters, field and aerial mapping of geology and surface manifestations of contamination, and examination and analysis of voluminous records of oilfield production activities.
- **Litigation Support, Confidential Client, Northwest Washington** - Provided technical support in evaluating the appropriateness and adequacy of the remedial investigation (RI), feasibility study (FS) and Cleanup Action Plan (CAP) for the site of a former wood treating facility located adjacent to a tidally influenced river in western Washington. Wood treatment included the use of creosote, Wolman salts (chromated copper arsenate), Minolith Fire retardant, and PCP with an oil carrier. After twenty years of use for wood treatment, the site was converted to an equipment maintenance facility for the adjacent sawmill. Soil and

groundwater were found to contain petroleum hydrocarbons, PCP, carcinogenic PAHs and arsenic. The proposed remedy included excavation of soil in the blow pit area, a barrier wall through the shallow aquifer to contain groundwater with high concentrations of wood treating constituents, a low permeability asphalt cap, and institutional controls. The key issues of importance were the accuracy of characterizations of sources for the contaminants found within and surrounding the site, the appropriateness of the proposed remedy, and the potential effects of the proposed remedy on the fate and transport of contaminants in groundwater adjacent to the limited area addressed by the remedy.

- **Injection Well Permit Application, Crystal Chemical, Houston, Texas** - Analyzed geologic and hydrologic data in preparation for testimony at Texas Water Commission hearings regarding a hazardous waste injection well permit application in the City of Houston.
- **Permit Support and Expert Testimony, F & R Cattle Company, Lingleville, Texas** - provided technical support and expert testimony in the permit amendment process for expansion of a calf-raising operation. The facility includes several types of confined feeding areas, a wastewater lagoon, manure spreading areas and spray irrigation of wastewater effluent. Permit opponents, who also had instituted a civil action, were alleging past and future effects on groundwater and surface water quality, including those as a result of seepage from feeding areas, the lagoon and irrigated fields. The confined feeding areas are underlain by limestone and shale whereas less consolidated sands and clays underlie the waste lagoon and irrigated fields. An ephemeral stream crossed the facility just below the wastewater lagoon. The facility structures and site conditions were evaluated on the basis of field surveys, published reports and records and surface water quality data. The site characteristics and the contaminant migration potential from each potential source area were evaluated, including seepage from the lined lagoon. Potential interactions between groundwater and surface water were assessed to address potential concerns that seepage from source areas could contribute to surface water quality degradation.
- **Expert Testimony, Amerada Hess, Terry County, Texas** - Principal investigator for an assessment of groundwater contamination resulting from oil production activities in the Texas panhandle. Provided expert testimony regarding the effects of these activities on groundwater quality.
- **Expert Testimony, Holt versus Amoco et al, Oryx Energy Company, Odessa, Texas** - Retained to provide litigation support and expert testimony for this civil action alleging damages to soil and water resources on a large ranch west of Odessa, Texas, of which Oryx Energy Company had production involvement on approximately nine square miles. MFG reviewed plaintiff's allegations and data and prepared preliminary opinions regarding potential damages to water resources. Oryx settled with the plaintiffs in 1997 prior to trial.
- **Technical Support, Metropolitan Mortgage & Securities, Inc., Spokane, Washington** - provided technical support in evaluating the adequacy and findings of the remedial investigation (RI) work plan, the RI and the feasibility study (FS) for the Central Steam Plant project in Spokane, Washington. Approximately 75,000 gallons of Bunker C fuel oil were released from underground storage tanks at the plant. The fuel oil affected a large volume of soil beneath the plant and adjacent properties to the north (downgradient) and had migrated with groundwater several hundred feet to the north. The bulk of the fuel oil was confined

within basalt bedrock lows trending north. Comments on the work plan, the RI report and the FS report were submitted to the Washington Department of Ecology. Subsequently evaluated the cleanup action plan (CAP), which included construction of a barrier wall, hydraulic control wells, product recovery, bioventing, and groundwater monitoring.

#### **SOLID AND HAZARDOUS WASTE MANAGEMENT**

- **Hazardous Waste TSD Facility Permitting, Laidlaw Environmental Services, Inc., Colorado County, Texas** - Managed the site investigation for a proposed commercial TSD facility in Texas and directed the preparation of the geology and groundwater monitoring reports for the Part B permit application. The investigation included stratigraphic, hydraulic and geochemical evaluations to identify potential pathways of contaminant migration.
- **Hazardous Waste Management and Permitting, Multiple Locations and Clients** - Provided regulatory and technical assistance to the owners of proposed and active commercial TSD facilities in California, Colorado, Pennsylvania, Quebec and Texas.
- **Landfill Investigation, Remediation and Permitting, Comanche Peak Steam Electric Station, Texas** - Managed the investigation of several closed industrial landfills, including the use of reconnaissance techniques (surface geophysics and soil gas monitoring) and subsurface methods (soil borings, monitoring wells, delineation drilling and waste excavations) to characterize the extent, contents and impacts of the landfills. Directed preparation of the post-closure Part B application.
- **Municipal Landfill Permitting and Groundwater Monitoring System Design, Multiple Locations and Clients, Texas** - Conducted hydrogeologic investigations, designed groundwater monitoring systems and prepared permit applications for several municipal landfills in Texas. Provided testimony in TNRCC hearings to support groundwater monitoring system design for a municipal landfill in central Texas.

#### **DUE DILIGENCE SITE ASSESSMENT**

- **Site Assessment, Highway 36 Facility, Concord Resources, Group Last Chance, Colorado** - Managed and conducted a pre-acquisition due diligence audit with respect to environmental monitoring for a commercial TSD facility in Colorado. Provided recommendations for substantially reducing the scope of monitoring programs.
- **Site Assessment, Metropolitan Mortgage & Securities, Inc., Spokane, Washington** - Managed the Phase I ESA and limited asbestos abatement for the acquisition of the 18-story Farm Credit Bank building and associated parking structures in downtown Spokane, Washington.

#### **WATER RESOURCE EVALUATION AND DEVELOPMENT**

- **Water Supply Evaluation, City of Denver City, Texas** - Managed a comprehensive water supply study to assess the long-term groundwater availability, water chemistry and infrastructure needs for the city, which is entirely dependent on the Ogallala Aquifer. A

numerical model of the aquifer system was constructed using MODFLOW and used to evaluate future water production scenarios and optimize wellfield design.

- **Water Supply Study, West Texas** - Conducted a groundwater resource study for a large ranch in West Texas. The study area included an alluvial aquifer, a bedrock aquifer, a surface water reservoir and several ephemeral streams. Mr. Frick designed the completion and testing of wells, constructed a numerical model of the groundwater flow system using MODFLOW and derived safe yield evaluations for several development scenarios. A key factor in locating and designing water supply wells was the variable total dissolved solids content of groundwater in the two primary aquifers.
- **Water Resource Planning, New Castle County, Delaware** - Conducted a county-wide assessment of the availability, utilization and contamination of water resources in New Castle County, Delaware under a contract with the U.S. EPA Office of Solid Waste Management Programs. The study included evaluation of the potential for various land-based facilities to impact water quality, including landfills, septic systems, waste lagoons, dredge spoil disposal areas, leaking underground storage tanks, accidental spills, feedlots and salt water intrusion as a result of overpumping. The impacts of these sources on present and future availability of water resources were evaluated. As the county hydrogeologist, he advised the Planning Department as to the impact of land development projects on the water resources of the county, particularly the impacts on aquifer recharge, evaluated the feasibility of artificial recharge projects, and conducted long-range water resource planning. He also represented the County at Delaware River Basin Commission and Coastal Zone Management Commission meetings.

#### **WATER QUALITY STUDIES**

- **CAFO Hydrogeologic Study, Confidential Client, Washington** - Project Manager for a preliminary hydrogeologic study for a confined animal feeding operation (CAFO) near Wallula, Washington. The study presented an evaluation of various site conditions and recommendations for a monitoring system to evaluate impacts to the environment and compliance with the Ground Water Quality Standards. The feedlot and the ancillary facilities used for wastewater and runoff containment are located on approximately 700 acres and the design capacity of the feedlot is 60,000 head of cattle. The investigation included a water well inventory, soil sampling and analysis, monitoring well completion, groundwater sampling and analysis, and sampling and analysis of wastewaters. The available groundwater data suggest that the waste management operations at the Facility have not had significant and/or measurable effects on groundwater quality. In addition, soils data from test pits in the penned areas indicated minimal potential for downward migration in the confined animal pens where a well-developed manure cake is present. Groundwater monitoring data suggest that seepage from impoundments to groundwater is minimal.
- **Groundwater Quality Assessment, San Angelo By-Products, San Angelo, Texas** - Project Manager for groundwater quality assessment in the vicinity of waste lagoons at an industrial recycling facility in West Texas. Evaluated potential impacts as a result of seepage from lined brine spray-evaporation ponds. Historic information suggested that fertilizer use on area farms had already impacted groundwater quality in the form of elevated nitrate and total dissolved solids. The investigation included installation of four monitoring wells, which were sampled for indicator waste constituents and general water quality parameters, and a



water well inventory. A comprehensive analysis of onsite and offsite groundwater flow conditions and water quality demonstrated that 1) groundwater quality had been degraded areawide by agricultural activities, 2) residences obtaining their drinking water supply from shallow wells were all upgradient of the facility, and 3) the impacts to groundwater quality as a result of seepage from the ponds were relatively slight and restricted to the plant property.

#### **MINE PERMITTING AND GROUNDWATER CONTROL**

- **Mine Permitting and Hydrogeologic Evaluation, Davey Johnston Mine, NERCO, Douglas County, Wyoming** - Managed the geologic and hydrogeologic baseline and probable hydrologic consequences investigations in support of the mine permit application. Groundwater occurred in both alluvial sediments and in level to steeply dipping sedimentary rocks, including the coal seam.
- **Mine Permitting and Groundwater Control System Design, Multiple Locations and Clients, Texas and Louisiana** - Conducted and/or managed hydrogeologic baseline studies, environmental impact assessments and groundwater control evaluations for surface lignite mines. Groundwater control evaluations often involved multiple aquifers and the design of large wellfields using numerical modeling techniques, principally MODFLOW. Provided expert testimony regarding the environmental impacts of mining and dewatering projects before the Railroad Commission of Texas and the Texas Water Commission.

#### **PROFESSIONAL EMPLOYMENT HISTORY**

Senior Consulting Hydrogeologist - MFG, Inc.; Washington (1986-Present)  
Senior Hydrogeologist - Hall Southwest Water Consultants, Inc; Texas (1983-1986)  
Senior Hydrogeologist - Hydro-Search, Inc.; Texas (1980-1983)  
Hydrogeologist - Espey, Huston & Associates, Inc.; Texas (1979-1980)  
Hydrogeologist - New Castle County Department of Public Works; Delaware (1973-1976)

#### **EDUCATION**

M.A., Geology - University of Missouri-Columbia (1980)  
B.S., Geology - University of Delaware (1973)

#### **PROFESSIONAL AFFILIATIONS**

American Institute of Professional Geologists  
Association of Engineering Geologists  
Association of Ground Water Scientists and Engineers, NGWA  
Northwest Geological Society

#### **PROFESSIONAL DEVELOPMENT/CONTINUING EDUCATION**

Monitored Natural Attenuation for Groundwater Seminar, EPA, December 1998  
Hazardous Waste Site Operations 40-hour Course, OSHA 29 CFR 1910.120 (1985) and refreshers

***PUBLICATIONS***

Pastor, E.F. and Frick, D.R., Considerations in Selecting Indicator Parameters for the Statistical Evaluation of Ground-Water Quality, in Current Practices in Ground Water and Vadose Zone Investigations, ASTM Special Technical Publication 1118, 1992.

Frick, D.R., and Shaffer, L., Assessment of the Availability, Utilization and Contamination of Water Resources in New Castle County, Delaware; prepared for Office of Solid Waste Management Programs, U.S. Environmental Protection Agency, Contract No. WA-6-99-2061-J, 1975.

***PRESENTATIONS***

Case Study: Planning and Implementation of CERCLA Remedial Action, presented at the Executive Enterprises Operating Under RCRA and CERCLA Requirements, June 1993.

Development of Cost-Effective Ground-Water Control Plans for Gulf Coast Lignite Mines; presented at the 115th AIME Annual meeting in New Orleans and the Annual Spring Meeting of the Association of Engineering Geologists, Texas Section in College Station, 1986.

Hydrogeology of Ordovician and Mississippian Age Limestone Aquifers in Southeastern Kansas and Southwestern Missouri; presented at 23rd Annual Midwest Groundwater Conference, Rolla, Missouri, 1978.

## **EXPERTISE**

Geochemical Analysis of Water, Soil, Rock, and Wastes; Aqueous Geochemical Modeling; Isotope Geochemistry; Contaminant Fate and Transport; Statistical Methods; and Data Management and Data Quality Evaluation.

## **PROJECT EXPERIENCE**

### **REMEDIAL INVESTIGATIONS/FEASIBILITY STUDIES/REMEDIAL DESIGN**

- Evaluated sampling approaches for soils in residential areas around a former lead smelter in Everett, Washington. The purpose was to select a sampling approach for identifying soils that require remediation and for confirming that the remediation levels have been achieved at individual residential properties. A "bootstrap" modeling method was used with data describing metals concentrations in soils in the residential area to simulate the performance of several different sampling and remediation approaches. The simulation model results will be used to select the approach that demonstrates the highest performance considering its cost effectiveness and implementability within the residential area.
- Managing Asarco's Kids First Program in Leadville, Colorado, a pilot program designed to identify and address sources of lead exposure for children in residential areas of the California Gulch Superfund Site. The program is implemented as an interim response action in conjunction with the Lake County Health Department and includes blood lead monitoring; environmental sampling and analysis of soil, paint, dust and drinking water samples; database management and reporting; community education programs; and remediation of potential sources of lead exposure at individual residences. The program has widespread support from the community and EPA and has been effective in reducing the percentage of Leadville children with elevated blood lead levels.
- Project manager for a \$1.5 million RI/FS at an inactive Cu-Pb-Zn mine in New Mexico. Acted as primary contact with client and regulatory agencies. Provided technical oversight for and coordination of field investigations, data management and analysis, and document preparation. Designed remedial investigation and monitoring programs for groundwater, surface water, sediments, and soil. Also co-wrote a field-investigation plan to determine the physical properties of the vadose zone and calculate a water balance for a 150,000-cubic-yard waste-rock dump.
- Prepared Remedial Design Reports for groundwater monitoring at a former lead smelter in central Utah and a fertilizer production facility in southern Idaho. Both designs included statistically based performance standards for evaluating the long-term effectiveness of remedial actions.
- Provided project management support and technical oversight to the Operable Unit 7 (Present Landfill) RFI/RI at the Rocky Flats Plant. Directed field implementation of the work plan. As the data-management coordinator, evaluated analytical data quality, assessed data usability, and conducted statistical analyses and statistical comparisons of onsite and background geochemical data to determine the extent of contamination at the site.

- Initiated development and implementation of standardized data-management and data-reduction procedures in support of large remedial investigations and regulated monitoring programs. These procedures assist in time-efficient reporting to regulatory agencies and provide technically defensible data for statistical analyses and site-characterization and risk-assessment studies.

#### **GEOCHEMICAL INVESTIGATIONS AND MODELING**

- Lead geochemist for an Engineering Evaluation/Cost Assessment of a former lead smelter in central Utah. Developed aqueous speciation and solute transport models for use in evaluating remedial alternatives related to arsenic contamination of shallow groundwater. Demonstrated effectiveness of monitored natural attenuation as remedial action for groundwater.
- Modeled chemical speciation, solubility and adsorption of lead (PHREEQC) leached from contaminated fill materials to demonstrate attenuation of lead transport by groundwater and to justify no further action at a construction site in San Antonio, Texas.
- Designed a series of batch adsorption tests to provide site-specific soil/water distribution coefficients for lead. The resultant sorption isotherms were used to model lead release and transport from surficial soils to groundwater. Results demonstrated that the soil-lead cleanup level used in a residential area was protective of groundwater quality.
- Developed methods for assessing metal contents of surface waters due to natural water-rock interactions within a large watershed in the northwest United States. A flow-load model based on empirical data from the site will be used to provide estimates of background metal concentrations within an extensive mining district. The model indicates that metals loading to surface water from natural weathering and erosion of undisturbed ore deposits results in elevated metals concentrations in the nearby surface water drainages.
- Evaluated fate and transport of cyanide, fluoride and arsenic originating from waste disposal units at the Alcoa (Point Comfort)/Lavaca Bay Superfund Site using analytical models to predict the concentrations of these parameters in groundwater at exposure points. Modeling results were used to support a baseline human health risk assessment and demonstrated that natural attenuation combined with chemical reaction mechanisms effectively reduced the concentrations of these parameters at the future downgradient exposure locations.
- Developed batch tests to evaluate the leaching characteristics of fly ash and a series of batch sorption tests to evaluate the natural attenuation characteristics of surrounding geologic materials for a proposed fly-ash disposal site in Texas. The test results describe the site-specific partitioning behavior of fly ash constituents leached to groundwater.
- Project manager and technical lead for the Sitewide Groundwater Geochemistry Report for the Rocky Flats Environmental Technology Site. Results from five years of groundwater monitoring were analyzed to provide a comprehensive description of groundwater geochemistry. Data analyses included geostatistical analysis (kriging), chemical-distribution mapping, and chemical mass-balance modeling (WATEQ4F, NETPATH).

- Author of report on environmental isotope study of groundwater at the Rocky Flats Environmental Technology Site. Summarized and interpreted the results of more than 1,000 oxygen and hydrogen isotopic analyses of precipitation, groundwater, and surface water samples from the site. Described the sources of recharge to and isotopic distinctions between two hydrostratigraphic units.

#### **STATISTICAL METHODS**

- Developed approach for the statistical evaluation of groundwater monitoring data at a chrome sludge landfill in Indiana. Prepared a detection monitoring plan and presented monitoring and statistical evaluation approaches to Indiana Department of Environmental Management for approval and incorporation into the existing post-closure permit. Sampling and analysis requirements were reduced while meeting existing permit requirements for landfill monitoring.
- Designed a post-closure groundwater monitoring program for a hazardous-waste disposal facility in northern Texas. Non-parametric prediction limits were adopted as performance standards for selected monitoring parameters (i.e., statistical methods of R. Gibbons) to meet EPA Subtitle C regulations. Sampling and analysis requirements were reduced relative to previous monitoring programs while achieving lower error rates and acceptable statistical power.
- Project manager and technical lead for the RCRA Groundwater Monitoring Report for Regulated Units at the Rocky Flats Plant. Managed a team of technical staff to provide the results of quarterly groundwater monitoring at three RCRA units (more than 100 wells) and acted as a technical advisor for statistical data-analysis tasks.

#### **ANALYTICAL CHEMISTRY/DATA QUALITY EVALUATION**

- Senior project chemist providing technical assistance and oversight in areas of data validation, data-quality evaluation, development of data quality objectives and statistical data analysis for remedial investigations at the Alcoa (Point Comfort)/Lavaca Bay (Texas) Superfund Site. Contaminants being investigated and potentially remediated at the site include mercury, arsenic, chromium, selenium, polynuclear aromatic hydrocarbons, chlorinated organics (including DNAPL phase), cyanide and fluoride.
- Developed ultra-clean, groundwater sampling methods for trace-level mercury and methylmercury analyses based on procedures in EPA's Method 1669. Appropriate sampling equipment and sample collection and handling methods were identified in a detailed standard operating procedure, which has now been used successfully on several sampling events.
- Conducted quality-assurance surveillances of remedial investigations being performed by subcontractors at the Rocky Flats Environmental Technology Site. Evaluated data management, data-quality analyses, and data-usability assessments for conformance with EPA guidance and DOE orders; assessed the technical defensibility of methods used for data reduction and analysis; made recommendations for resolution of deficiencies; and provided the client with written summaries of the surveillance findings.

## **GEOLOGIC CHARACTERIZATION**

- Conducted geologic mapping and stratigraphic analysis to compile a geologic map of a 60-square-mile area that includes the Rocky Flats Plant as part of the Sitewide Geologic Characterization. Prepared a report detailing the stratigraphy and structure of bedrock units and describing a conceptual model for the geologic setting of the plant. The resultant model was used to identify areas where future contaminant migration via groundwater transport was most likely to occur and to select detection monitoring locations.
- Conducted geochemical studies of silicic volcanic rocks from sites across the western United States (including the Nevada Test Site - Yucca Mountain area) using radiogenic isotopes (Nd/Sm and Rb/Sr) as tracers in petrogenesis. Also conducted high-precision strontium isotopic analyses of bivalve shells for a geochronology study of Arctic marine deposits, and managed the clean-room and mass-spectrometry facilities at CIRES.
- Conducted geologic field mapping and mineral resource assessments of five Bureau of Land Management Wilderness Study Areas in northern Nevada and southern Oregon and Idaho.

## **PROFESSIONAL EMPLOYMENT HISTORY**

Senior Geochemist - MFG, Inc.; Colorado (1996-Present)  
Senior Geochemist/Project Manager - The S.M. Stoller Corporation; Colorado (1990-1996)  
Graduate Research Assistant - Cooperative Institute for Research in Environmental Science, University of Colorado; (1986-1990)  
Geologist - U.S. Geological Survey; California (1984-1986)

## **EDUCATION**

Ph.D., Geological Sciences - University of Colorado at Boulder (1990)  
B.A. (*magna cum laude*), Geology with Honors - Hamilton College (1984)

## **PROFESSIONAL AFFILIATIONS**

Geological Society of America  
International Association of Geochemistry and Cosmochemistry

## **PROFESSIONAL DEVELOPMENT/CONTINUING EDUCATION**

Geoenvironmental Analysis of Ore Deposits, Society for Mining, Metallurgy and Exploration 8-hour short course (2000)  
Manufacturer's Training Course for the NITON Spectrum XRF Analyzer (2000)  
Statistical Methods in Water Resource Evaluation, International Ground Water Modeling Center, Golden, Colorado, 40-hour short course (1995)  
Modeling of Chemical Reactions in Groundwater, International Ground Water Modeling Center, Golden, Colorado, 40-hour short course (1992) - Introduction to use of MINTEQA2, WATEQ4F, NETPATH, and PHREEQE modeling programs.

40-Hour OSHA Hazardous Waste Site Health and Safety Training (updated yearly).

## ***PUBLICATIONS***

Sanders, F., M. Marcus and K. Tegtmeier. Preliminary evaluation of arsenic removal from secondary treated municipal wastewater in anaerobic, surface-flow constructed wetlands. Accepted by Water Environment Federation for presentation at WEFTEC 2000 conference, 2000.

Tegtmeier, K.J. Regional variations in the Nd and Sr isotopic compositions of Tertiary peralkaline rhyolites from the Great Basin, western U.S., Transactions American Geophysical Union, v. 71, p. 1682-1683, 1990.

Tegtmeier, K.J. and G.L. Farmer. Nd isotopic gradients in upper crustal magma chambers: Evidence for in situ magma-wall rock interaction, *Geology*, v. 18, p. 4-9, 1990.

Tegtmeier, K.J., G.L. Farmer, and D.E. Broxton. Isotopic evidence for the origin of late Tertiary metaluminous and peralkaline rhyolites from the Great Basin, western U.S., International Association of Volcanology and Chemistry of the Earth's Interior Abstracts, New Mexico Bureau of Mines and Mineral Resources Bulletin 131, p. 266, 1989.

Tegtmeier, K.J. and G.L. Farmer. Nd isotopic gradients in large volume peralkaline rhyolites: Evidence for wall rock interaction in upper crustal magma chambers, Geological Society of America Abstracts with Program, v. 20, p. A249, 1988.

Minor, S.A., J.J. Rytuba, C.A. Goeldner, and K.J. Tegtmeier. Geologic Map of the Alvord Hot Springs Quadrangle, Harney County, Oregon, U.S. Geological Survey Miscellaneous Field Studies Map, MF-1916, 1988.

Tegtmeier, K. and G.L. Farmer. Nd isotopic evidence for the origin of large-volume, extension-related peralkaline rhyolites from the Great Basin, western U.S., Transactions American Geophysical Union, v. 86, p. 1512, 1987.

Peterson, J.A. and K.J. Tegtmeier. Geologic Map of the Dry Creek Quadrangle, Malheur County, Oregon, U.S. Geological Survey Miscellaneous Field Studies Map, MF-1940, 1987.

Minor, S.A., J.J. Rytuba, M.J. Grubensky, D.B. Vander Meulen, and K.J. Tegtmeier. Geologic Map of the High Steens and Little Blitzen Gorge Wilderness Study Areas, Harney County, Oregon, U.S. Geological Survey Miscellaneous Field Studies Map, MF-1876, 1986.

## ***PRESENTATIONS***

Tegtmeier, K.J., M.K. Vaag, M.C. Broussard, and J.W. Langman. Surface Geologic Mapping at Rocky Flats Plant, Jefferson County, CO: An often overlooked, inexpensive, non-intrusive method for characterizing groundwater contaminant transport pathways, Geological Society of America Abstracts with Program, v. 23, 1991.

*LANGUAGE PROFICIENCY*

French (good reading and writing ability)



## **EXPERTISE**

Agricultural Systems; Hydrology; Soil Erosion Assessment; Soil and Water Quality Investigation; Environmental Permitting; Remedial Design; and Vegetation Establishment and Reclamation Planning.

## **CERTIFICATION**

Certified Assessor - National Pork Producers Council On-Farm Odor/Environmental Assistance Program (1998)  
Professional Engineer - California, No. C-58853 (1999)  
Professional Engineer - Idaho, No. 7427 (1994)  
Professional Engineer - Colorado, No. 28019 (1992)

## **PROJECT EXPERIENCE**

### **AGRICULTURAL SYSTEMS**

- **D&D Farms, LLC, Holyoke, Colorado.** Technical assistance for permit application and compliance with manure management regulations for 240,000-head pork producer.
- **Seaboard Farms, Inc.; D&D Farms, LLC; Triple R Farms; Midwest Farms, LLC; Newsham Hybrids (USA) Inc.; and Bell Farms.** Odor measurement survey for five large pork producers at various locations relative to operations (e.g., nearby residences, property boundaries, lagoons, and building ventilation outlets) in eastern Colorado.
- **Confidential, Colorado.** On-farm odor/environmental assessment for pork production facilities.
- **Hecla Mining Company, Coeur d'Alene, Idaho.** Irrigation plan development, water quality assessment, and soil analyses for land application of wastewater from a mine impoundment to a pasture in northeastern Washington. Included analysis of nitrate loading and soil-water balance on a monthly basis.
- **H.M. Charles and Sons, Lancaster County, Pennsylvania.** Crop, pork, and beef production; equipment operation; and construction.

### **HYDRAULICS AND HYDROLOGY**

- **Asarco Incorporated, Salt Lake City, Utah.** Water balance analysis for contaminated-material repository to be constructed as part of a roadway base at a former lead smelter site in the Salt Lake City area; review of floodplain studies to assess potential for impingement from 100-year flood waters.

- **Asarco Incorporated; Union Pacific, Northern Idaho.** Hydraulic modeling of stream and river flow characteristics using HEC-RAS. Applied model to review previous floodplain study for a stream in central Colorado. Also, led HEC-RAS modeling and design effort for flood protection of railroad embankments along Coeur d'Alene River, Idaho.
- **Tri-State Mining District; Cyprus Amax Mine.** Hydrologic modeling and analysis for watersheds and drainages in rural or urban/industrial areas in Texas and Kansas; detention pond design for rural mine site in Kansas; and project management for conceptual design of dust suppression system on 2500-acre mill tailings impoundment in Arizona.
- **Colorado State University, San Luis Valley, Colorado.** Lead researcher for consumptive use (ET) and groundwater study in southern Colorado. Conducted development of ET measurement methodology, instrument calibration, and data collection and evaluation.

#### **CONTAMINANT TRANSPORT, HYDROLOGIC, AND EROSION PROCESSES**

- **Panoche/Silver Creek Watershed CRMP, Mendota, California.** Project manager and lead technical consultant for watershed erosion study in western San Joaquin Valley, California. Work involved characterization of erosion sources and hydrology in 300-square mile watershed, with detailed study in 30-square mile area. Also, utilization of nonpoint source model to evaluate erosion and hydrology.
- **The Pennsylvania State University.** Researcher of hydrologic, erosion, and nutrient transport processes associated with several crop tillage methods; conducted study utilizing high-intensity simulated rainfall to generate runoff from field plots; compared four tillage methods for hydrologic response, peak flow rate, soil loss, particle size distribution, nutrient loading, enrichment, and other parameters necessary to assess differences in processes associated with the dynamic runoff event. Part of the research included evaluation of field-measured data relative to results obtained from application of the WEPP model.
- **Alcoa, Pt. Comfort, Texas.** Mercury loading prediction for 200-acre industrial island on Gulf Coast. Evaluated hydrology and soil loss using the Water Erosion Prediction Project (WEPP) model. Coupled soil loss with mercury concentrations (enrichment) to assess pre- and post-remediation conditions for mercury loading.
- **Asarco Incorporated, Leadville, Colorado.** Evaluation of surface water flow and quality trends for a high-altitude Superfund site in central Colorado, including characterization of contaminant sources, transport mechanisms, groundwater-surface water interactions, and chemical mass loading.

#### **RECLAMATION/REMEDIAL DESIGN**

- **Various clients in the Rocky Mountain West.** Review and development of remediation and reclamation plans for industrial and mine sites; assessment of soil contamination and proposed remedial actions; remedial design sampling plan development for surface and subsurface soils; assessment of soil quality; development of vegetation establishment specifications; hydrologic modeling for various sites using TR-55 and other methods; HEC-1 runoff routing; stormwater drainage control structure design; repository hydrologic evaluation

and balance using the HELP model; HEC-2 water surface profile modeling for channel modifications, bridges, and culverts; and stream channel rehabilitation design.

- **Gulf Resources and Chemical Corporation, Coeur d'Alene, Idaho.** Participated in Remedial Investigation (RI), Feasibility Study (FS), and development of remedial master plans for the Bunker Hill Superfund site in northern Idaho. Work involved consumptive use estimation for annual water budget; sheet, rill, and gully erosion evaluation and conceptual design of erosion control structures; and hydrologic modeling. Other RI/FS activities included soil and solid material sampling and evaluation; co-author of comprehensive RI Report; and co-author of FS Report for evaluation of reclamation alternatives for abandoned ore processing facilities, barren hillsides, and floodplain.
- **Gulf and Western Industries.** Remedial planning and implementation at the Eagle Mine Superfund site, near Vail, Colorado, including hydraulic design for ditches and other flow control structures; revegetation program development, design, and implementation for disturbed areas; vegetation test plot development and monitoring, seed mixture design, and pH measurements and adjustment; sampling for surface-water quality, vegetation, and soils; and reclamation plan development/permit application for borrow operation.

### ***PROFESSIONAL EMPLOYMENT HISTORY***

Senior Agricultural Engineer - MFG, Inc.; Colorado (1993-1994 and 1997-Present)  
Graduate Research Assistant/Instructor/Ph.D. Fellow - Department of Agricultural and Biological Engineering, Penn State University; Pennsylvania (1994-1997)  
Project Civil/Agricultural Engineer - Dames & Moore; Colorado (1987-1992)  
Graduate Research Assistant - Department of Agricultural and Chemical Engineering, Colorado State University; Colorado (1985-1987)  
Agricultural Production Technician - H.M. Charles and Sons; Pennsylvania (1975-1983)

### ***EDUCATION***

Ph.D., Agricultural and Biological Engineering - Penn State (1997)  
M.S., Agricultural Engineering - Colorado State University (1987)  
B.S. with distinction, Agricultural Engineering - Penn State (1985)  
Vocational Agriculture program, Lancaster County, Pennsylvania, 1979; included involvement in Future Farmers of America (FFA), obtained State degree

### ***PROFESSIONAL AFFILIATIONS***

Affiliate Faculty Member, Department of Chemical and Bioresource Engineering, Colorado State University  
Alpha Epsilon Agricultural Engineering Honor Society  
American Society of Civil Engineers  
National Ground Water Association  
Tau Beta Pi Engineering Honor Society

***PROFESSIONAL DEVELOPMENT/CONTINUING EDUCATION***

National Pork Producers Council (NPPC) On-Farm Odor/Environmental Assistance Program, Sterling, Colorado, 1998.  
Manure Management Workshop, Colorado State University Extension, La Junta, Colorado, 1998.  
Mine Safety and Health Administration, Certificate of Training (8 hrs) for safety, 1994.  
Sediment Transport Calculations, HEC-6 Microcomputer Applications, University of California at Davis, 1993.  
Urban Surface Water Management Workshop, ASCE Continuing Education, 1992.  
Hazardous Waste Site Health and Safety Training (40 hrs OSHA Hazardous Waste Operations Standard 1910.120), 1987; 8-hour refresher, current annual requirement met; 8-hour supervisor training, 1992.  
High Altitude Revegetation Workshop, Ft. Collins, CO, 1990; Tour, 1991.  
Water Surface Profile Modeling Using HEC-2, ASCE Continuing Education, 1991.

***PUBLICATIONS***

McCulley, Frick & Gilman, Inc. 1998. Technical Memorandum - Estimate of Mercury Loading from Dredge Island to Lavaca Bay via Stormwater Runoff, Port Lavaca, Texas for ALCOA (primary author of document).

McCulley, Frick & Gilman, Inc. 1998. Panoche/Silver Creek Watershed (PSCW) Assessment Report, Mendota, California for PSCW Coordinated Resource and Management and Planning Group (CRMP) (editor and primary author of document).

Charles, F.L. 1997. The hydrologic and erosional effects from using slit tillage. Doctor of Philosophy thesis, Penn State University, University Park, Pennsylvania.

Charles, F.L. and A.R. Jarrett. 1997. Comparison of the runoff and soil loss effects for four tillage treatments. ASAE Paper No. 97-xx.

McCulley, Frick & Gilman, Inc. 1993. South Fork Coeur d'Alene River (SFCDR) Floodway Remedial Design Report, Bunker Hill Superfund Site, Kellogg, Idaho for Pintlar Corporation (primary contributor to document).

Dames & Moore. 1992. Draft Sampling and Analysis Plan (SAP), Jasper County RI/FS for Seven Designated Areas (overall plan manager and editor).

Dames & Moore. 1991. Conceptual Design Report, Sprinkler Irrigation Dust Suppression System, Sierrita Tailings Impoundment for Cyprus Sierrita Corporation, Green Valley, Arizona (author of document).

Dames & Moore. 1991. Pad A Feasibility Study (FS) Report for EG&G, Idaho National Engineering Laboratory, Idaho Falls, Idaho (author of document).

Dames & Moore. 1991. Draft Remedial Investigation (RI) Report, Bunker Hill Superfund Site, Kellogg, Idaho for Gulf Resources and Chemical Corporation (author of sections on soils, land use, vegetation, surface water characterization and analysis).

Engineering Ministries International. 1991. Agricultural Production Master Plan, Orphanage Emmanuel, Guaimaca, Honduras (author of document).

Charles, F.L. 1987. Evapotranspiration of phreatophytes in the San Luis Valley, Colorado. Master of Science thesis, Colorado State University, Fort Collins, Colorado.

Charles, F.L., J.A. Morgan and W.C. Bausch. 1987. Evapotranspiration of native vegetation in the closed basin of the San Luis Valley, Colorado. Colorado Water Resources Research Institute, Colorado State University, Fort Collins, CO. Completion Report No. 143.

Charles, F.L., W.C. Bausch and J.A. Morgan. 1987. Evapotranspiration of phreatophytes in the San Luis Valley, Colorado. ASAE Paper No. 87-xx.

### ***PRESENTATIONS***

Sediment Source Assessment for the Panoche/Silver Creek Watershed in the Central Coastal Range, California. Big Thompson Watershed Forum, Loveland, Colorado, November 18, 1998 and Colorado State University, Ft. Collins, Colorado, December 2, 1998.

Panoche/Silver Creek Watershed Assessment, State Water Resources Control Board, Sacramento, California, October 30, 1998.

Comparison of the runoff and soil loss effects for four tillage treatments. Presented at the 1997 Annual ASAE International Meeting, Minneapolis, Minnesota.

Evapotranspiration of phreatophytes in the San Luis Valley, Colorado. Presented at the 1987 ASAE Summer Meeting, Baltimore, Maryland.

Instructor for three-credit college technical course for three semesters (1995-1997); responsible for all aspects of technical course content development and administration. Course content included: thermodynamic energy, hydraulics, animal building structure and ventilation analysis; electrical circuits. Consistently rated "excellent" by students for overall quality of instructor.

### ***AWARDS***

Ph.D. Departmental Fellowship, Penn State, August 1994 to May 1997  
Student Marshal at Penn State Commencement, May 1985  
Outstanding Senior Award, Penn State, 1985

### ***LANGUAGE PROFICIENCY***

Spanish (conversational)



***Air, Surface, Water, Land and  
Groundwater Environments***

## ***Treatment and Remediation***







## **OFFICE LOCATIONS**

### **CALIFORNIA**

Arcata  
Irvine  
San Francisco

### **COLORADO**

Boulder

### **FLORIDA**

Jacksonville

### **IDAHO**

Osburn

### **MONTANA**

Missoula

### **NEW JERSEY**

Edison

### **PENNSYLVANIA**

Pittsburgh

### **TEXAS**

Austin  
Houston  
Port Lavaca  
Texarkana

### **WASHINGTON**

Seattle

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## **CORPORATE HEADQUARTERS**

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